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ASSESSMENT OF AGRICULTURAL  
RESEARCH RESOURCES  
IN THE SAHEL

VOLUME III  
NATIONAL REPORT: MALI

by

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## PREFACE

### ASSESSMENT OF AGRICULTURAL RESEARCH RESOURCES IN THE SAHEL

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<sup>1</sup>Each national report is printed separately.

<sup>2</sup>As this report was going to the printers in August 1984, the change of name of "Upper Volta" to "Burkina Faso" was announced. While Upper Volta was the correct name of the country as of the date of the inventory (December 1983), readers should take note of this recent change.

## LIST OF ACRONYMS AND ABBREVIATIONS

AB	Wheat Action, Dire
ACCT	Agency for Technical and Cultural Cooperation
ADRAO	See WARDA
AGRIDOC	Counsel on Agricultural Documentation
AGRIS	International System of Information for the Sciences and Agricultural Technology
AP	Paper Workshop
APS	Pastoral Activity of the Sahel
ARS	Flood Recession Action for Rice and Sorghum, Gao
AV	Veterinary Assistant
BAC	High School Diploma (Baccalaureat)
BAD	African Development Bank
BALIMA	Libya-Mali Arab Bank
BCM	Central Bank of Mali
BDM	Malian Development Bank
BEPC	General Education Certificate
BLAO	International Bank for West Africa
BMCD	Malian Credit and Deposit Bank
CAA	Agricultural Apprenticeship Center
CAPA	Agricultural Vocational School Diploma
CARIS	International Information System on Current Agronomic Research
CCCE	Central Bank for Economic Cooperation (France)
CDR	Center for Rural Development
CEAO	West African Economic Community
CEDEAO	See ECOWAS
CFC-MLII	Livestock Extension Training Centers - Mali Livestock II
CFN	Niger River Basin Commission
CFPF	Forestry Practical Training Center
CIDA	Canadian Agency for International Development
CILSS	Permanent Inter-State Committee for Drought Control in the Sahel
CIMMYT	International Center for Maize and Wheat Improvement
CIPEA	See ILCA
CMDT	Mali Textile Development Corporation
CNRA	National Committee of Agricultural Research
CNRF	National Center for Fruit Research
CNRZ	National Center for Animal Husbandry Research
COP	Practical Orientation Center
CRST	Technical and Scientific Research Commission of the African Unity
CRZ	Animal Husbandry Research Center
CST	Scientific and Technical Committee
CTBS	Center for Savannah Wood Technology

CTFT	Technical Center for Tropical Forestry
DAF	Administrative and Financial Division
DDI	Division of Documentation and Information
DEF	Diploma of Basic Studies - end of middle school
DET	Technical Studies Division
DMA	Agricultural Machinery Division
DNAFLA	National Directorship for Functional Literacy and Applied Linguistics
DPE	Division of Planning and Analysis
DRA	Agricultural Research Division
DRFH	Forestry and Hydrobiology Research Division
DRSPR	Farming Systems Research Division
DRT	Regional Veterinary Division
DRV	Regional Veterinary Directorate
DRZ	Animal Husbandry Research Division
ECIEEV	Cattle and Meat Credit Bureau
ECICA	Central School for Industry, Commerce and Administration
ECOWAS	Economic Community of West African States
EEC	European Economic Community
EIV	School for Veterinary Attendants
ENA	National School for Administration
ENHEP	National School for Higher Applied Studies
ENI	National Engineering School
ENMP	National Medical and Pharmacological School
ENPT	National Postal and Telecommunications School
ENTF	Teacher Training College for Women's Technical Instruction
ENSEC	Teacher Training College (Secondary Level)
ENSUP	Teacher Training College (Superior Level)
ESS	Health Training College (Secondary Level)
FAC	Fund for Cooperation and Aid (France)
FAO	United Nations Food and Agriculture Organization
FED	European Development Fund
FM	Mali Franc
FSD	Saudi Arabian Development Fund
GERDAT	Group for Studies and Research on the Development of Tropical Agriculture
GDP	Gross Domestic Product
GNP	Gross National Product
GR	Rural Engineer
IAM	Mediterranean Agronomic Institute
ICRISAT	International Crops Research Institute for Semi- Arid Tropics
IDA	International Development Association

IDRC	International Development Research Center (Canada)
IDESSA	Savannah Institute
IEMVT	Institute of Livestock and Tropical Veterinary Medicine
IER	Rural Economics Institute
IFAC	Institute for Colonial Fruits and Citrus
IFAN	Fundamental Institute of Black Africa
IFARC	Institute for Agronomics and Rural Training in Hot Climates
IFC	International Finance Corporation
IFDC	International Fertilizer Development Center
IITA	International Institute of Tropical Agriculture
ILCA	International Livestock Center for Africa
IMF	International Monetary Fund
INA	National Institute for the Arts
INRZFH	National Institute for Animal Husbandry, Forestry and Hydrobiology Research
IPD-AOS	Pan-African Development Institute - West Africa - Sahel
IPR	Institut Polytechnique Rural
IRAT	Research Institute for Tropical Agriculture
IRCT	Institute for Research on Cotton and Textiles
IRRT	Royal Institute for Tropical Regions
ISAA	Engineer of Agricultural Applied Sciences
ISAE	Engineer of Applied Sciences in Water and Forestry
ISRA	Senegalese Institute for Agronomy
ITA	Agricultural Works Engineer
ITE	Livestock Engineer
ITF	Forestry Engineer
IV	Veterinary Attendant
LCV	Central Veterinary Laboratory
LHM	Mopti Hydrobiology Laboratory
MA	Ministry of Agriculture
MAECI	Ministry of Foreign Affairs and International Cooperation
MCDR	Ministry of Rural Development
MDR	Ministry of Rural Development
MECE	Ministry of Equipment
MECEP	Ministry of Planning and Economics
MF	Ministry of Finance
MIT	Ministry of Information and Telecommunications
MI	Ministry of the Interior
MP	Ministry of Planning
MS	Ministry of Health
MTFP	Ministry of Labor and Civil Service

OAPF	Management and Forestry Production Operation
CARS	Sikasso Management and Reforestation Operation
OAU	Organization of African Unity
OBT	Sikasso Tea Operation
OCLALAV	Organization for the Control of Insect and Bird Pests
ODEM	Livestock Development Operations of Mopti
ODIB	Baguineda Integrated Development Operation
ODIK	Kaarta Integrated Development Operation
ODIPAC	Integrated Development Office for Groundnut and Cereal Production
ODR	Rural Development Operations
OECD	Organization for Economic Cooperation and Development
OERHN	Office for the Control of the Upper Niger Hydraulic Resources
OHV	Upper Valley Operation
OICMA	International Organization for the Control of Locusts
OMBEVI	Malian Livestock and Beef Office
OMM	Millet Operation, Mopti
OMVS	Senegal River Basin Commission
OMVSO	Sategui Deressia Basin Commission
ON	Niger Office
ONDY	N'Dama Yanfolila Operation
ONPS	National Seed Production Operation
OPAM	Mali Agricultural Products Bureau
OPEC	Organization of Petroleum Exporting Countries
OPM	Fishing Operation, Mopti
OPNBB	National Park Operation of "La Boucle du Baoule"
OPSR	Seed Protection and Harvest Conservation Operation
OPSS	Selected Seed Production Operation
ORM	Rice Operation, Mopti
ORS	Rice Operation, Segou
ORSTOM	Office of Overseas Scientific and Technical Research
OTS	Sikasso Tea Operation
OVSTM	Operation for the Senegal, Terekole and Magui Valleys
OZL	Lacustre Zone Operation
PAM	World Food Program
PAR	Research Support Operations Base
PEP	Permanent Experimentation Base
PFRS	Sikasso Border Project
PIRT	Land Resources Inventory Project
PPS	Primary Productivity in the Sahel
PRODESO	Livestock Development Project in the Sahel Occidental

RESADOC	Sahel Documentary Network
SAFGRAD	Semi-Arid Food Grains Research and Development
SCAER	Agricultural Credit and Rural Equipment Corporation
SEPAMA	Citrus Fruit Production Corporation of Mali
SEPOM	Oil Products Corporation of Mali
SERZ/S	Sahel Animal Husbandry and Livestock Research Station
SERZ/T	Toronke Livestock and Animal Husbandry Research Station
SFI	International Finance Corporation
SFI	Research Station for Irrigated Forestry Plantations
SMECMA	Malian Corporation for the Study and Constitution of Agricultural Equipment
SOMIEX	Mali Import-Export Corporation
SRBEA	Research Station on the Biology of Autochthonous Species
SRCFJ	Cotton and Jute Research Stations
SRCSS	Selected Seeds Control Research Station
SRCVO	Food and Oil Crops Research Station
SREF/MN	North Mopti Research Station for Grazing Experiments
SRFM	Vegetable Crops Research Station
SRTPM	Tobacco and New Plants Research Station
SUCO	Canadian Overseas University Service
TSA	Senior Technician in Agriculture
TSE	Senior Technician in Livestock
TSEF	Senior Technician in Water and Forestry
TSGR	Senior Technician in Rural Engineering
UDPM	Democratic Union of the Malian People
ULB	Bamako Milk Producers Union
UN	United Nations
UNDP	United Nations Development Program
USAID	United States Agency for International Development
WARDA	West African Rice Development Association
ZASA	Program for Arid and Semi-Arid Zones

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## INTRODUCTION

### A. Background

The Agricultural Research Resources inventory and assessment for Mali was also conducted in the remaining seven countries of the Sahel (Cape Verde, Chad, Mauritania, Niger, Senegal, The Gambia and Upper Volta), all of which are member countries of the CILSS, the Permanent Interstate Committee for Drought Control in the Sahel. The eight national reports taken together comprise Volume III of this report. They are bound separately and are available from the United States Agency for International Development in Washington.<sup>1</sup>

The inventory and assessment was carried out within the framework of the high priority accorded by the member countries of the CDA (Cooperation for Development in Africa) and the CILSS to the need to develop and strengthen agricultural research capability in the region. As the World Bank noted in its September 1983 report entitled "Sub-Saharan Africa: Progress Report on Development Prospects and Programs"<sup>2</sup>:

"Even within the present state of technical knowledge, improved incentives and marketing arrangements would permit very large increases in agricultural output [in Africa]. However, for the longer term, increased output will depend on the development of effective technical packages, pest and disease control and developments in animal husbandry... In a situation of budgetary stringency and of immediate crises, expenditure on research having a possible, but uncertain payoff, ten years or more in the future is frequently seen as dispensable. This danger is increased when research programs are manifestly weak and unfocused. It is, therefore, essential that these programs be formulated and implemented in ways which will enable them to contribute more effectively to the process of development..."

The CDA is an informal association of donors including Belgium, Canada, France, Italy, West Germany, the United Kingdom and the United States. The United States, assisted by other CDA donors, was assigned

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<sup>1</sup>Volume II, Summary of Agricultural Research in the Sahel, contains summaries of each of the eight countries' national reports. Volume I is a "Regional Analysis of Agricultural Research Resources in the Sahel". Both may be obtained from AID as well.

<sup>2</sup>World Bank, Sub-Saharan Africa: Progress Report on Development Prospects and Programs, Washington, D.C., World Bank, (September 1983, pp. 30-31.

the specific responsibility for coordinating the development of CDA-supported agricultural research programs in the Sahelian and Southern African regions.

This CDA initiative responds to initiatives already undertaken by many national governments and regional entities (such as the OAU, and CILSS) to emphasize the development of a strong capability in the Sahel to increase agricultural productivity. The donors, therefore, joined with African regional agencies such as INSAH in the Sahel and the Southern Africa Development Coordination Conference (SADCC) in Southern Africa to develop country-specific, regionally-sensitive analyses of existing resources and to identify medium- to long-term needs and opportunities in support of agricultural research that will lead to increased agricultural productivity.

The assessment and preparation of this report were financed by the U.S. Agency for International Development (AID) and carried out by DEVRES, Inc., a U.S.-based private contractor located in Washington, D.C. engaged by AID. DEVRES was assisted by two sub-contractors, the Institut du Sahel (INSAH) and the Midwest Universities Consortium for International Activities (MUCIA). INSAH was established in 1976 and given prime responsibility by CILSS for the collection, analysis and dissemination of research results; for the promotion and coordination of research; for the training of researchers and technicians; and for the adaptation and transfer of technology. The MUCIA consists of seven universities, with administrative headquarters at Ohio State University. Michigan State University was identified by MUCIA as its lead institution for this assessment due to its experience in Africa.

The CDA mandate for the assessment and this report preparation was to consider programs up to 20 years in duration. Few specific project ideas were developed with this timeframe in mind. However, in developing proposals for future programs, this long term emphasis maximized flexibility to focus on the needs of agricultural research regardless of the timeframe involved. Ultimately, the research priorities and activities were set out as needed, while remaining sensitive and responsive to the severe budgetary constraints in the Sahelian countries.

## B. Methodology

Sahelian participation in the process of carrying out the inventory and assessment--the collection of data, the preparation of national reports, and the subsequent regional assessment--has been a central aspect of the design and implementation of this study. In May 1983, INSAH, cooperating with DEVRES, invited agricultural researchers from Mali and other Sahelian countries to INSAH headquarters in Bamako, Mali to discuss the study and examine the first draft of a series of questionnaires intended to inventory the resources (both

physical and human) available for agricultural research in the region. The questionnaires were then revised in light of the researchers' knowledge of the technical areas and local conditions.

Senior researchers from each of the Sahelian countries were hired by INSAH as National Coordinators and placed in charge of obtaining the answers to the questionnaires and preparing the national reports for their respective countries. National Coordinators in turn hired experienced researchers for short periods of time in their respective countries to help with the completion of the questionnaires in specific subject matter areas such as export and food crops, livestock, agro-forestry, fisheries, and farming systems. The questionnaires included not just the research institutions in these fields, but also the training institutions, and the extension institutions which provide the link between the research and the farmers who utilize the research results.

DEVRES fielded a team of experienced agricultural researchers and development specialists to assist the National Coordinators and their staffs, help with the establishment of a data bank at INSAH on research resources, and develop the regional program. The DEVRES staff consisted of a team leader, a regional coordinator, a technical consultant, one sub-regional coordinator for Cape Verde, The Gambia, Mauritania and Senegal, and another for Chad, Niger, and Upper Volta. Mali was assisted by the technical consultant stationed in Bamako. In addition, INSAH made available two of its senior staff--the Director of its Research Department and the Coordinator of the Research and Documentation network (RESADOC)--who were responsible for coordination between the DEVRES staff and the National Coordinators. MUCIA participated in the design of the questionnaire, furnished country background data for the survey and the sub-regional coordinator for the Eastern Sahel.

INSAH, because of its regional responsibilities for coordination of agricultural research and dissemination of the results, became the repository of the results of the questionnaires in the form of a data bank located at INSAH headquarters. The data collected from the study has been organized using a standard software package--"dBase II"--and can be accessed on the microcomputers available at INSAH headquarters.

More information on potential uses of the data bank can be found in Volume I. The survey has been an important first step in creating a data bank which (when combined with other information available at INSAH) will provide a foundation of practical, useful data that can be updated and refined. It will be a valuable tool for those designing programs and projects in agricultural research in the Sahel and it will also be a source of providing information for researchers in the Sahel and in other neighboring countries.

The inventory and assessment were carried out from May 1983 to April 1984. The bulk of the data collection and the writing of the national reports were carried out from September to December 1983 by the National Coordinators and their consultants in cooperation with the DEVRES/INSAH staff. The national reports are essentially the product of the work of the National Coordinators, assisted by their consultants, based on the responses to the questionnaires. The regional analysis and research strategy were developed by the DEVRES staff in consultation with INSAH in light of the national reports, the questionnaire, and contacts with international research organizations, bilateral and multilateral donors and development organizations (such as the Club du Sahel, the various UN agencies, and the World Bank) and other written information available to the team. The DEVRES/INSAH staff collaboratively designed the proposed regional projects and activities to carry out the strategy elements.

In carrying out the inventory and analysis and in preparing recommendations for programs and projects in this report, the national Coordinators team made special efforts to take into account research work already carried out, underway or proposed. This is consonant with one of the principal objectives of the assessment--to seek ways to strengthen existing national and regional research activities. Further, specific recommendations are placed in a wide context, involving not only the research institutions, but also the training of researchers and the dissemination of research results to the farmers.

## II. GENERAL INFORMATION ON MALI

### A. Notes on Geography and Ecology

#### 1. General facts

Mali is a landlocked country, covering an area of 1,240,192 km<sup>2</sup> in the heart of West Africa between the Sahara, Sudan and Sahel regions. It is surrounded by seven countries: Mauritania, Algeria, Upper Volta, the Ivory Coast, Guinea, Senegal and Niger. (See Figures 1 and 2.)

Mali's principal administrative regions are:

- o First region: Kayes;
- o Second region: Koulikoro;
- o Third region: Sikasso;
- o Fourth region: Segou;
- o Fifth region: Mopti;
- o Sixth region: Timbuktu;
- o Seventh region: Gao; and
- o The District of Bamako.

The principal rivers of Mali are:

- o The Senegal: The Senegal River flows through the northwestern part of Mali for about half of its total length of 1,700 km. It has numerous tributaries (the Bakaye, fed by the Bacule; the Kolimbine with its tributary the Ouadou; the Karakoro; and the Falémé). Its average rate of flow — which varies considerably with the seasons — is 669 m<sup>3</sup>/s; and
- o The Niger: One of Africa's largest rivers, the Niger flows through Mali for 1,700 km of its total 4,200 km length. Its topography varies greatly. Around Mopti, it forms a huge inland delta. In other areas, it expands to create lakes, and it crosses into the neighboring country of Niger in the form of rapids.

Only limited navigation is possible on these two great rivers, and this is restricted to a short annual season.

# MALI

Situation au  
31 Décembre 1976

Feuille  
publiée



en cours  
ou prévue



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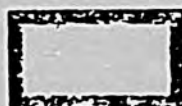
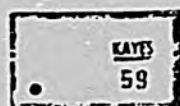
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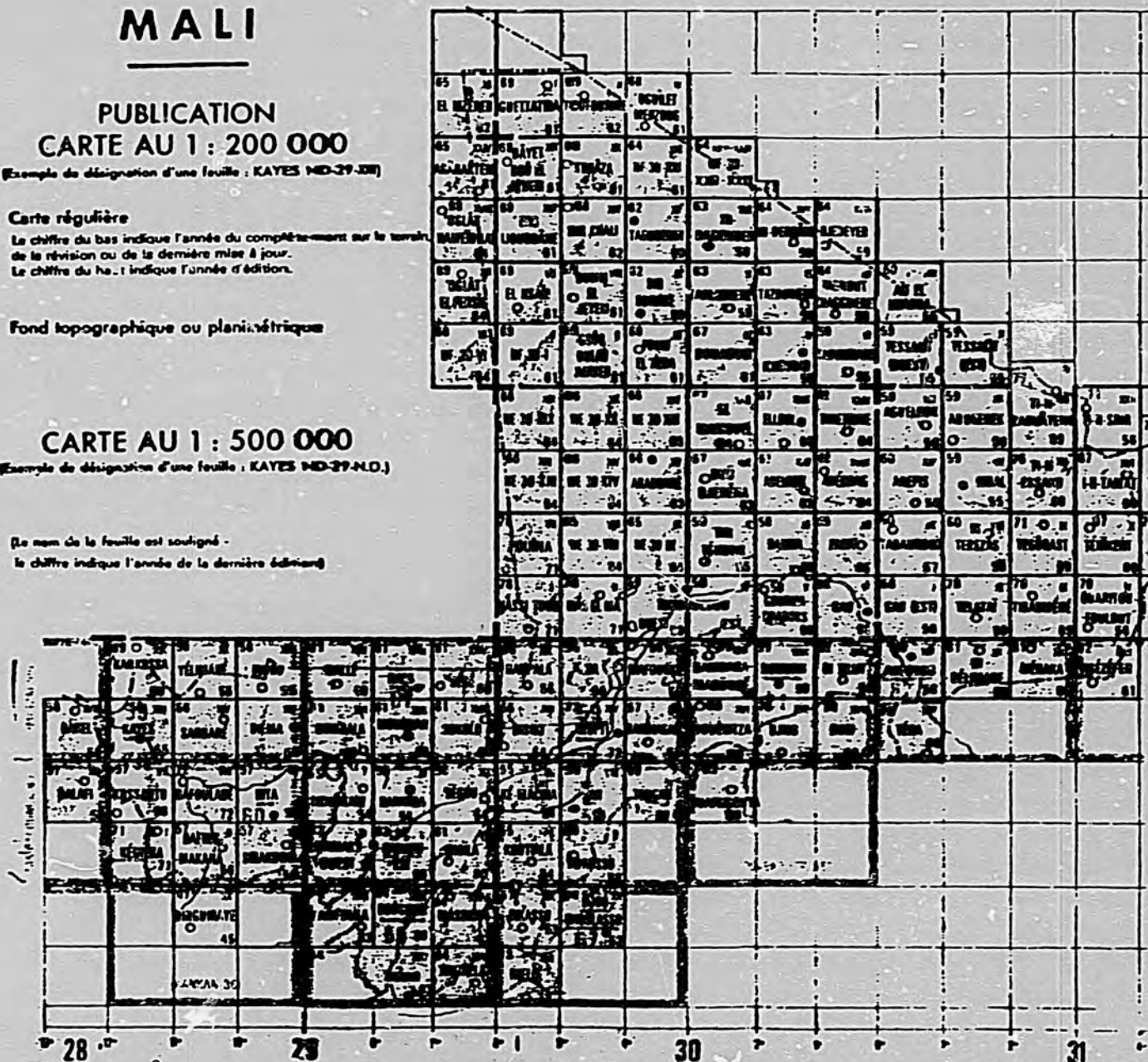


Figure 1: Map of Mali

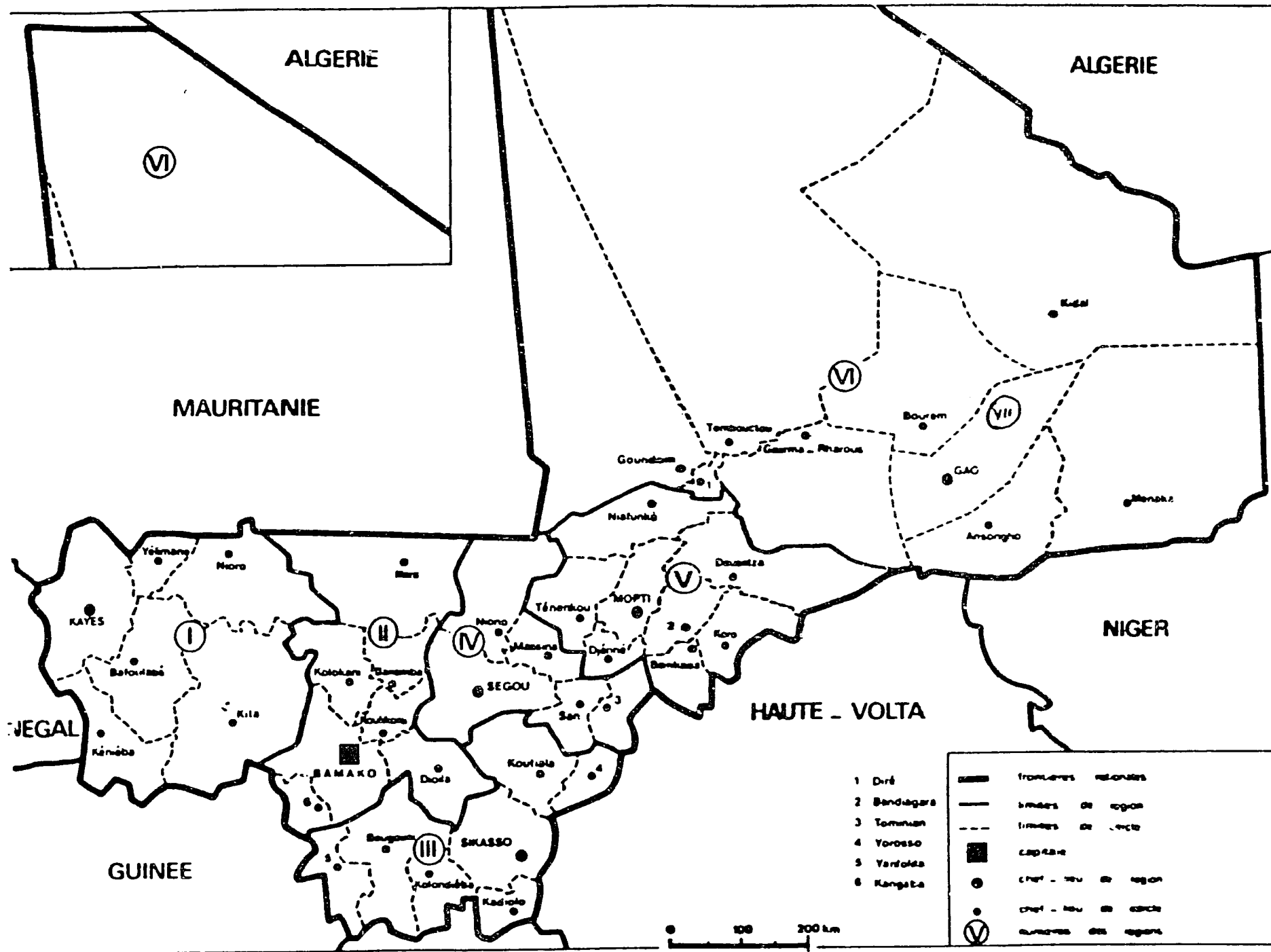


Figure 2: Administrative Map of Mali



The principal cities of Mali are: Bamako, the national capital, with 650,000 inhabitants; Segou, with 100,000 inhabitants; Gao, with 40,000 inhabitants; Timbuktu, with 35,000 inhabitants; Koutiali, with 27,597 inhabitants; Koutiali, with 27,597 inhabitants; Kati, with 24,991 inhabitants; and San, with 22,962.

## 2. Ecological region

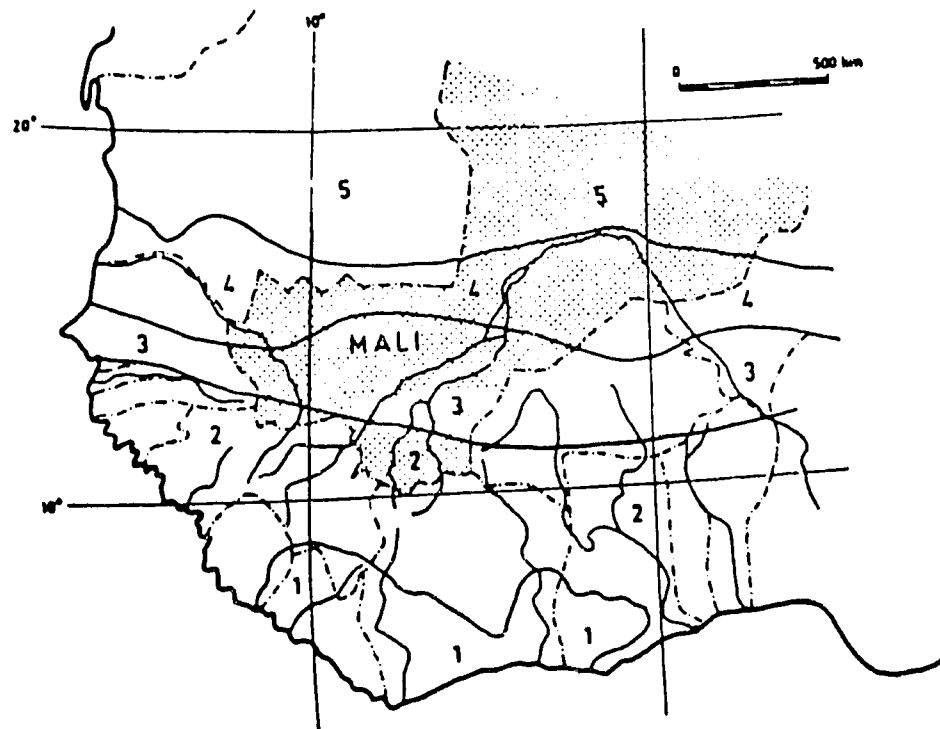
On an agricultural basis, there are five major zones. (See Figures 3 and 4.)

- o The Southern region bordering the Sudan and Guinea between latitudes 11° and 12° north. Average annual precipitation ranges from 1,300 mm to 1,700 mm; there is a lengthy rainy season (up to six months). Temperature variations during the year are not great. Damp grasslands and sparse woodlands form a mosaic. The tsetse fly is found here;
- o The Sudanese region, three times as large as the previous area. Rainfall ranges from 1,300 mm in the south to 700 mm in the north. Average temperatures during the hot season are higher than during the cool. The rainy season lasts from June to October. The sparse woodlands of the south become savanna (dry grasslands) towards the north;
- o The Sahelian region, located between latitudes 13° and 16° or 17° north. Rainfall ranges from 700 mm in the south to 200 mm in the north. There are some 30 days of rain each year, between June and September. There is a very lengthy dry season. Vegetation is sparse. This is also a vast nomadic area, with livestock-raising the principal occupation of the population;
- o The Niger Inland Delta, about 300 km long and 100 km wide. This becomes an immense lake during the flood season. It provides excellent grazing during the dry season; and
- o The Saharan region, to the north, located above latitude 17°. Annual rainfall is under 200 mm. Precipitation is irregular and unexpected, often in tornado form. Temperatures are very high and vegetation sparse.

Five years of severe drought during the 1970s have affected savanna plant life and grazing lands. Vegetation has diminished as more northerly species tended to push south.

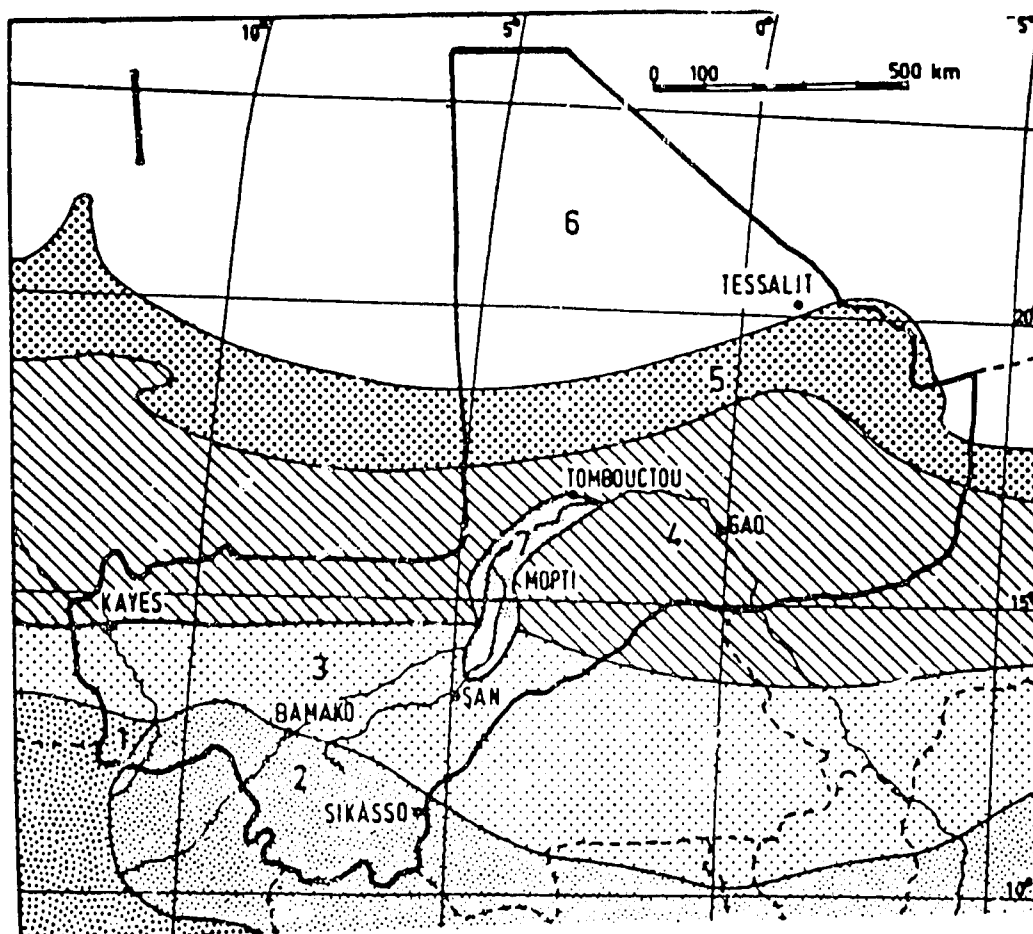
## 3. Topography and relief

Mali is a flat country, with high plains rising to between 200 and 350 m. In the northeast, there are the Adrar des Iforas hills and in the southwest, the Fouta Dialon range. These ranges vary between 500 and 800 m in height. Dune formations are also found in the north and center of the country. (See Figure 5.)



- 1 - South-Sudanian Zone (Guinean) = Wooded Savannah
- 2 - Sudanian Zone = Wooded, grassy Savannah
- 3 - Sahelian Zone = Thorny Steppe
- 4 - Inner Delta Zone
- 5 - Saharan = Desert

Figure 3: Map of Climatic and Vegetation Zones in West Africa



- 1 - Sparse Forests        )
- )
- 2 - Wooded Savannah     ) - Sudanian Zone
- )
- 3 - Grassy Savannah     )
- )
- 4 - Wooded Thorny Steppe - Sahelian Zone
- 5 - Sub-desert Steppe     - Saharan Zone

Source: UNESCO 1959

Figure 4: Vegetation and Ecological Zones in Mali



#### 4. Methods of travel and communication

##### a. Highways

In 1981, there were 18,000 km of roads, of which 7,500 km were open all year round. Some 1,600 km of the 6,500 km of main highways are paved.

Highway connections are good between Bamako and Koulikoro, Bamako and Segou, Segou and Niono, Bougouini and Sikasso and across the border towards Abidjan, as well as from Kayes to Segala and from Bamako to Kouremale (on the border of Guinea). (See Figure 6.)

##### b. Railroads

The railroad network covers 645 km.

There is a Bamako-Dakar line which goes via Kayes and a short line between Bamako and Koulikoro. (See Figure 6.)

##### c. Airports

Air transportation plays a vital role in this vast country.

In 1978, Bamako-Senou International Airport handled 148,450 passengers, compared with only 58,400 in 1970. There are airports at Gao, Kayes, Mopti-Sevare, Niono and Timbuktu, in addition to a number of short landing strips.

Airlines serving Mali are Air Mali, Air Afrique, Air Algerie, Air Guinee, Aeroflot, Interflug, and UTA.

##### d. Telephone and telecommunications

Extensive use is made of airmail facilities. Where no telephone service is available, urban centers are linked to the capital by radio. The 1977 figures show 78,000 telephones in Mali, with 2,000 of these in Bamako.

A telex network (cable in Bamako) plays an important part in the development of commerce and international relations.

##### e. Radio

The radio station is in Bamako (Radio-diffusion du Mali — Mali Broadcasting — with affiliate stations). The country had 90,000 receivers in 1981.

##### f. Television

Television was introduced in 1983.



## 5. Climate

Located between latitudes 10° and 24° north in the heart of the West African continent and far from the sea, Mali's successive continental climatic zones can be broken down from north to south as follows:

- o The Saharan climate, characterized by annual rainfall under 200 mm — always very uncertain (Tessalit, Kidal, Timbuktu); very high temperatures ranging from 35° to 50° C.
- o The Sahelian climate, divided into north and south: the north Sahelian climate — 200 to 400 mm (Menaka, Ansongo, Gao, Groundam, Niafunke). This is the great nomadic area, with temperatures ranging from 25° to 38° C. and the south Sahelian climate — 400 to 700 mm (Hombori, Mopti, Nioro, Segou, Kayes, San). Temperatures range between 25° and 32° C; and
- o The Sudanese climate, with a south-Sudanese or Guinean climate in the south: 700 to 1,000 mm (Koutiala, Bamako, Kita, Bougouni, Sikasso, Kenieba, Yanfolila, Falea). Temperature may fall as low as 20° C.

In these first two climatic regions — Saharan and Sahelian — the air is very dry except in the rainy seasons. (See Figures 7 and 8.)

There are two principal seasons: the dry season, from November to the end of May, and the rainy season, from June to October. Cool winds (trade winds) blow from November to January, sometimes lowering temperatures in Bamako to 15° C. From February to June, warm winds (harmattans) dry the air and increase the temperatures.

## B. Demography

### 1. Population

Before the 1976 census, population figures were supplied by the statistical yearbook, agricultural inquiries and population research of 1960/61. Current figures derive from information obtained in the 1976 census.

#### a. General census information

According to the 1976 census, Mali had 6,308,320 inhabitants. In 1980 it would have had 6,700,000 inhabitants and in 1983, 7,200,000. The annual increase is 2.5 percent. The 1990 projection is 8,000,000 inhabitants. Less than 15 percent of the population lives in the cities.

The population distribution in eight major regions is below. The population density in 1980 was 5.6 persons per km<sup>2</sup>.

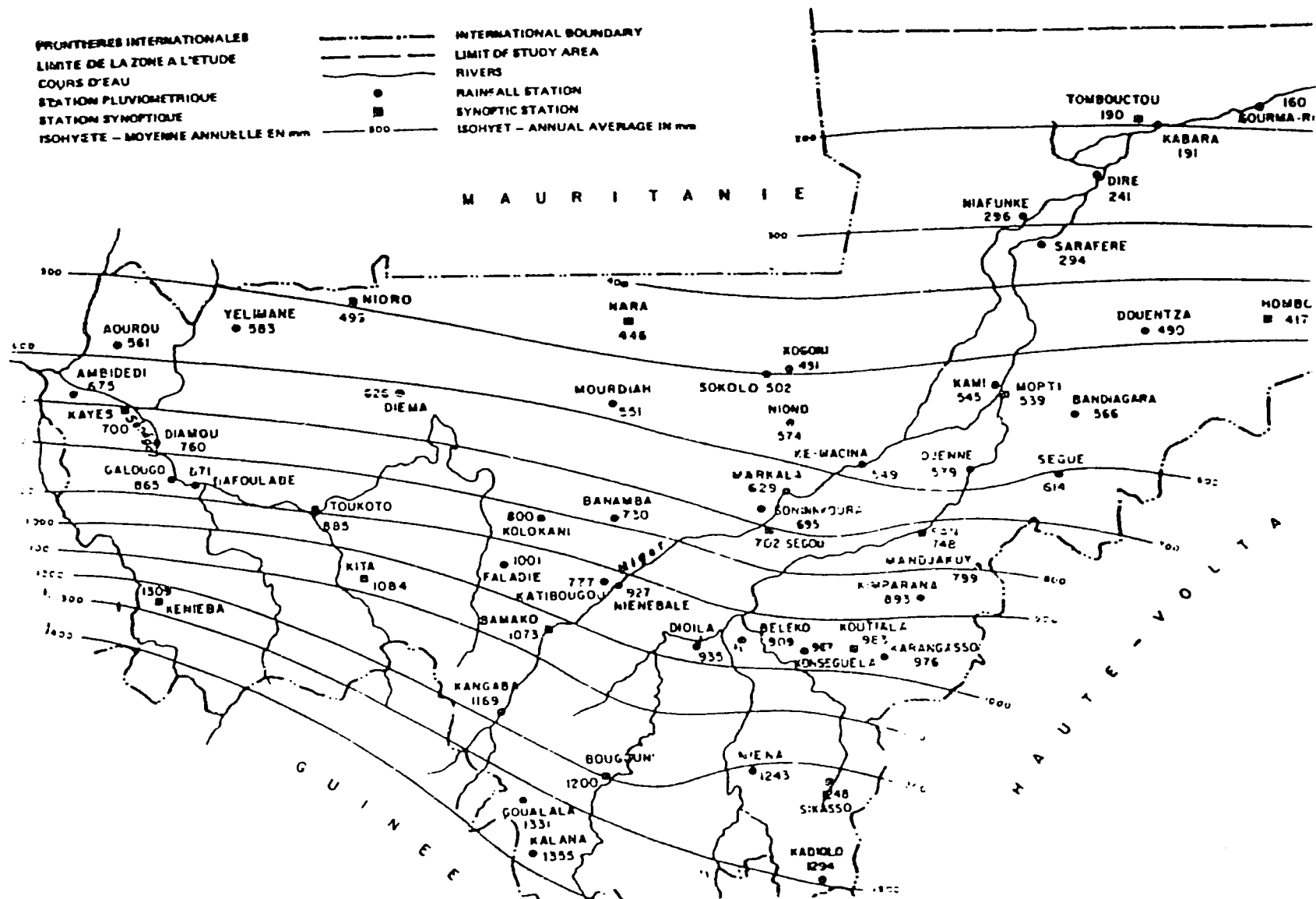
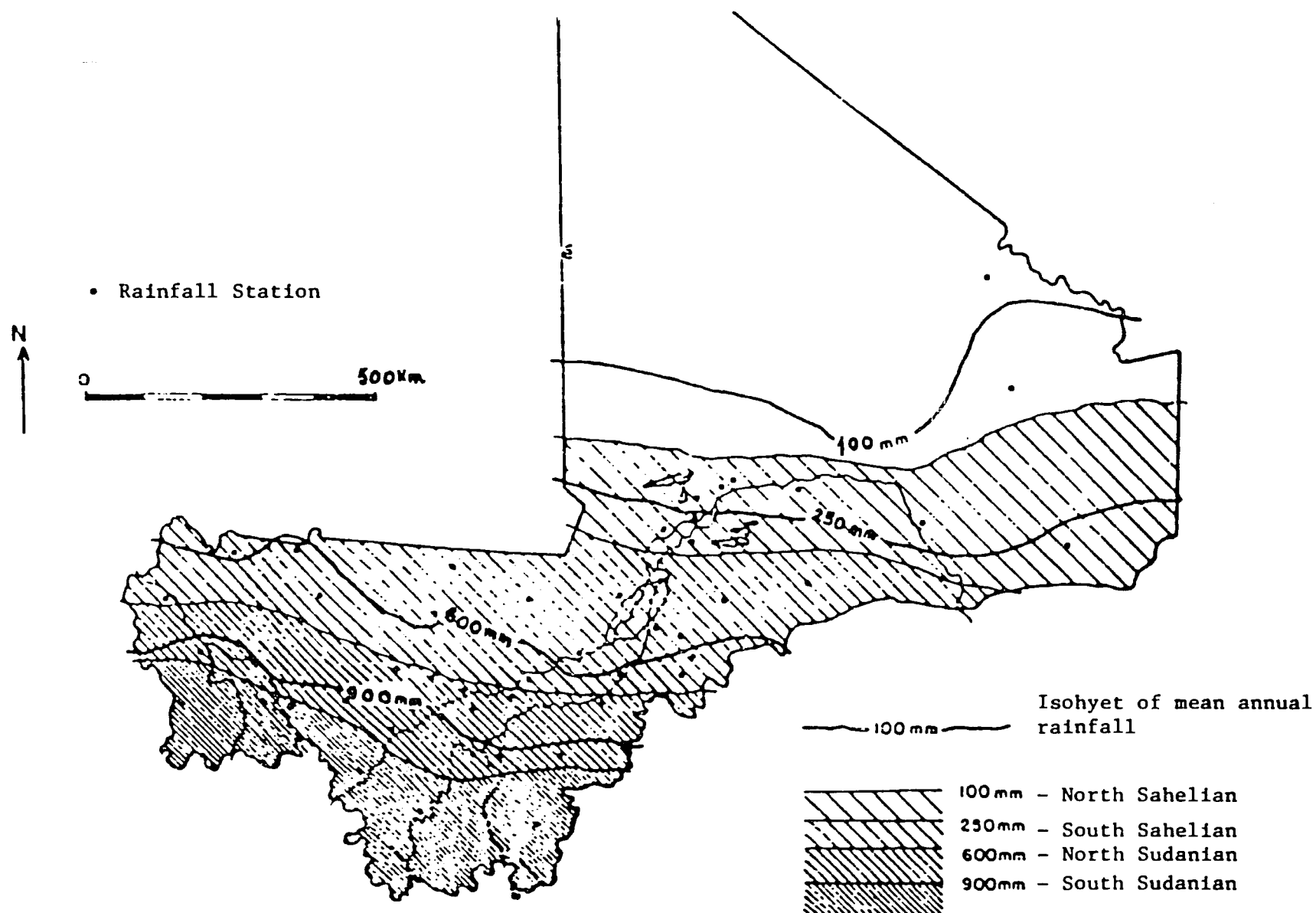


Figure 7: Rainfall Isohyets, 1922-1980





Source: Cartographie des pays du Sahel, Republique francaise, Ministry of Cooperation, 1976  
(from ORSTOM files)

Figure 8: Annual Rainfall in Mali

b. Ethnic groups (1980)

Several ethnic groups are found. (See Figure 9.)

- o The Manding group: 40 percent of the total population:
  - The Bambara: 2,500,000 distributed all across the country;
  - The Malinke: 460,000 located between Bamako and the Guinean border;
  - The Dioula: 90,000 occupied in agriculture and commerce. They are located between Bamako and the borders of Upper Volta, the Ivory Coast and Guinea.
- o Sudanese group: 20 percent of the total population:
  - The Sarakole: 640,000 in the Senegal Valley and the northwest area of the country;
  - The Songhai: 460,000 in the Niger bend;
  - The Dogon: 365,000 in the Bandiagara highlands.
- o Voltaic group: 10 percent of the total population:
  - The Senoufo and Minianka: 650,000 in the southeast area of the country; and
- o Others: 20 percent of the total population.
  - The Bobo: 150,000 in the northeast;
  - The Peul (Fula): 830,000 in the Mopti region of the Niger inland delta, mostly engaged in livestock raising;
  - The Bozo and Somono: 20,000 Niger fishermen;
  - The Moors: 90,000 nomads in the Sahel;
  - The Touareg: 45,000 nomads in the northeast;
  - The Khassonke: 120,000, based in the Kayes region in the western part of the country.

c. Religions

Of the total population, 85 percent are Muslim, 5 percent are Christians, and 10 percent of other religious faiths.

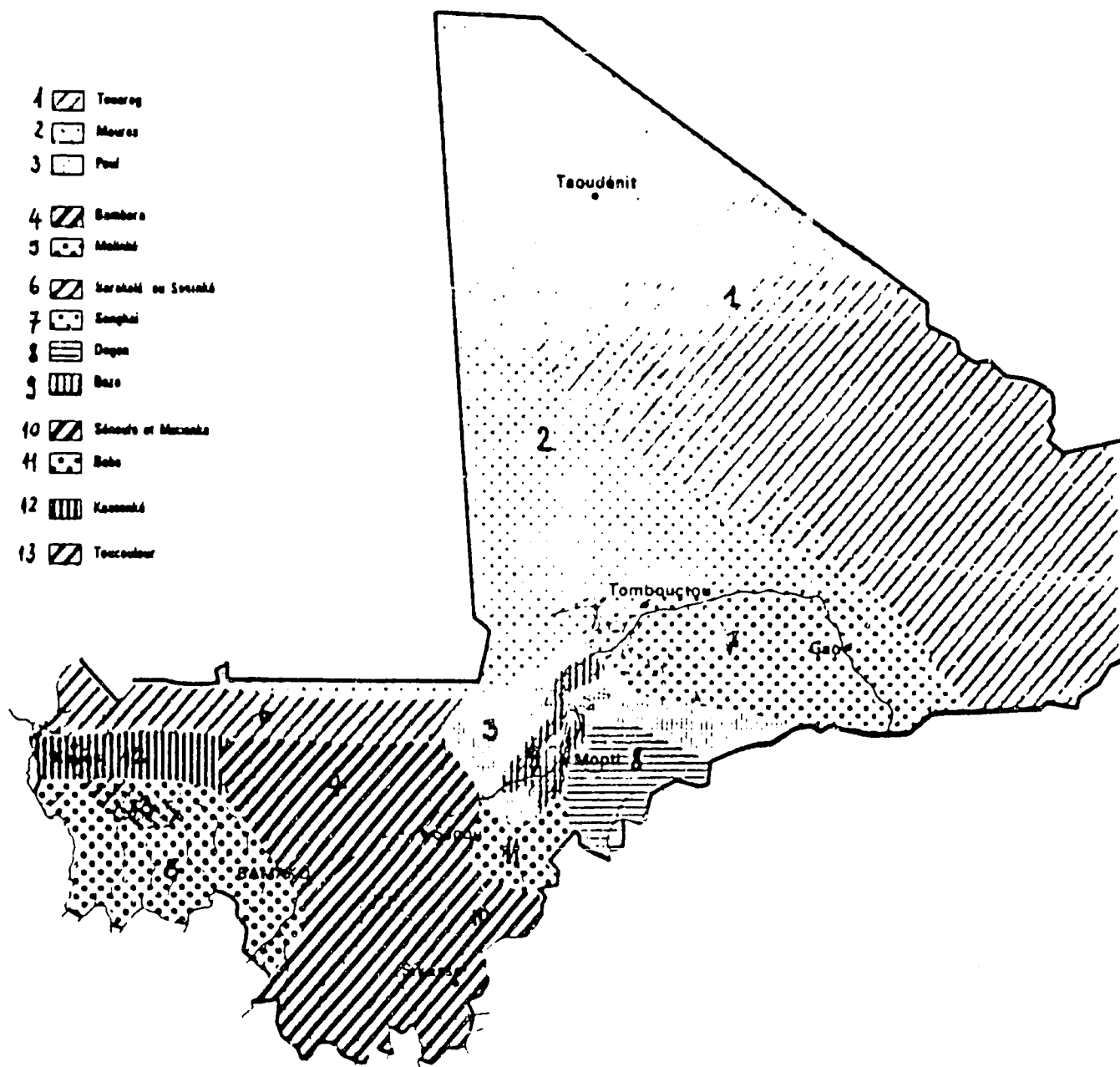


Figure 5: Ethnic Groups

Source: Jeune Afrique - Atlas Afrique, 1980

d. Languages

French, the official language, is spoken only by the educated. Bambara is spoken by 80 percent of the population.

2. Labor force breakdown

a. City dwellers

Only 14 percent of the population works in the cities.

A little under half are employed in industry and commerce. The remainder are employed in government services. Women comprise some 20 percent of the wage earners, which is a much higher figure than for many other African countries.

b. Rural areas

Mali's rural dwellers are engaged in a wide variety of occupations.

In several areas, there are three different methods of cultivation:

- o Intensive cultivation with fertilizer where work is carried out mostly by women, also called market gardening;
- o The more fertile fields are located close to low lying areas where land can be irrigated. Crops include rice, cotton, onions and fruit trees. Here again, women perform a large part of the work; and
- o The Forobas constitute virtual bush-fields, with large-scale cultivation widely practiced on a cyclical basis.

Only the Niger Service provides any hydraulic facilities to counteract climatic vagaries and increase crop yield. Farming is thus totally dependent on natural climatic and weather conditions. This makes adequate planning impossible, leading to recurrent food production disasters during the drought years, when crops may have to be sown two or even three times, before rainfall triggers germination. In the absence of fertilizer, soil recovery requires lengthy fallow periods — whose duration today tends to diminish under population pressures. Fallow land areas are estimated as being five or six times greater than those under cultivation.

All the work must be carried out during the very brief rainy season, which decreases from south to north (five months at Sikasso, three months at Mopti and two months at Gao). The scarcity and inequitable distribution of rainfall could be counteracted by efficient water resource management along the major waterways.

### 3. Migration

#### a. Exterior

The past 15 years have seen an almost uninterrupted flow of workers from Mali to the Ivory Coast, Nigeria, Senegal, Ghana and Europe. Part of their earnings are returned to Mali.

#### b. Interior

As a result of the great drought, the major urban centers have witnessed an inflow of permanent settlers. In addition, following each year's harvest, farm workers migrate to the cities to spend a few months.

### 4. Education

There were 350,636 pupils attending primary school in 1978 (75,000 in 1962); 7,800 classes in 1978 (1,500 in 1962); and 3,572 post-primary students in 1977 (104 in 1954). The enormous effort in this area since 1962 has resulted in the literacy of 35,000 adults, in more than 1,300 centers. These great strides resulted from an October, 1962 reform which completely overhauled the education system inherited from the colonial era. Designed for the collective enhancement of the entire Malian society, the reform plan replaced the former system with schools accessible to all and designed to meet national socioeconomic needs. These structural changes resulted in the establishment of the following three educational levels.

#### a. Basic education

This is composed of two stages, the first for a period of six years, the second for three years. Graduates receive the Basic Education Certificate (DEF-Diplôme d'études fondamentales), offering access to further studies. In the north, teaching is accomplished through nomadic schools (cantines). From 1970, Arab first-stage primary schools (medersas) have sprung up in all Bamako districts and in the major cities (Kayes, Segou, Sikasso, Mopti, etc.), taking over progressively from the Koranic schools.

#### b. Trade and technical training courses

These second-stage training courses are aimed at developing the middle management structures required for economic development. Courses run from two to four years.

There are a number of second-stage trade and technical institutions:

- o The Applied Trades Center (CPP-Centre professionnel pratique);
- o Agricultural Training Centers (CAA-Centre d'apprentissage agricole);

- o Veterinary Assistants' College (EIV-Ecole des infirmiers vétérinaires);
- o Point G Nurses Training College;
- o Social Workers Training College;
- o Practical Orientation Centers (COP-Centre d'orientation pratique);
- o The Police Academy;
- o The National Arts Institute; and
- o The National Postal and Telecommunications School.

These institutions award a certificate of studies.

Secondary and technical schools include:

- o The Pedagogical Institute of General Education (IPEG-Institut pédagogique d'éducation générale);
- o Women's Technical Teachers' Training College (ENTF-Ecole normale féminine d'enseignement technique);
- o Secondary Teachers Training College (ENSEC- Ecole normale secondaire);
- o Katibougou Rural Polytechnical Institute (IPR-Institut polytechnique rural, technician stage);
- o Health Services' Secondary School (ESS-Ecole secondaire de la santé);
- o The School of Commerce, Industry and Management (ECICA-Ecole de commerce, d'industrie et d'administration);
- o Police Inspectors' Academy; and
- o Advanced Technical Studies.

Graduation from these institutions provides access to further education.

#### c. General secondary education

General secondary education is for a three-year period culminating in a graduation certificate. Also included are the Franco-Arab schools. Instruction is given at secondary education lycées (high schools).

#### d. Higher education

In the absence of its own university, Mali's upper management training takes place in its advanced colleges, namely:

- o Advanced Teachers' Training College (ENSUP-Ecole normale supérieure);
- o National Administration School (ENA-Ecole nationale d'administration);
- o National School of Engineering (ENI-Ecole nationale d'ingénieurs);
- o National School of Medicine and Pharmacy (ENMP-Ecole nationale de médecine et de pharmacie);
- o Katibougou Rural Polytechnic Institute (IPR) (engineer stage);
- o National School of Higher Practical Studies (ENHEP-Ecole nationale des hautes études pratiques); and
- o National Postal and Telecommunications College.

Courses at the last two institutions are for a period of two years.

A number of Malian students attend foreign universities (Europe, America, Africa) for their further education.

Only about one-third of primary students move on to the secondary level. There is acute over-crowding at the upper levels. Only 20 percent of children attend school.

The number of students in 1977 is shown in Table 1.

#### e. Adult education facilities

Functional literacy at the rural level is taught at the Functional Literacy and Applied Linguistics Institute (DNAFLA-Direction nationale de l'alphabétisation fonctionnelle et de la linguistique appliquée). The Institute aims at providing an adequate flow of information to the people. Educational television was launched in 1971 to ensure pedagogical training and stimulation. Due to lack of facilities, however, it is confined to the Bamako District.

Literacy is also a priority in a country where 90 percent of the adult population cannot read or write. Efforts are being made in the national languages, but as yet only a minority can benefit. Finally, within the context of integrated development operations, rapid training courses are provided to male and female adults.

Table 1: Description of Educational System, 1977

<u>Level</u>	<u>Number of Institutions</u>	<u>Number of Teachers</u>	<u>Number of Students</u>
Primary	1,263	8,280	291,966
Secondary	18	540	11,524
Higher (Mali)	6	435	2,920
Outside Mali	-	-	1,365



Despite enormous efforts and considerable complementary support from the private sector, especially at the secondary level, almost one-third of the national budget is earmarked for education. This situation is compounded by rapid population growth and economic stagnation. In spite of all these difficulties, however, definition and establishment of an education system adapted to national realities remains the basic goal of the various levels of authority concerned.

f. Agricultural training institutes

The institutes providing training in agriculture are:

- o EIV (Veterinary Assistants' College) - Bamako. Approximately 60 students are recruited each year from the BEPC level (BEPC not required);
- o CAA (Agricultural Training Centers) - Samanko and Same. Accepts approximately 60 students each year from the BEPC level (BEPC not required);
- o Center of Practical Training and Forestry of Tabacoro; Bamako. Recruits about 25 students each year from the BEPC level (BEPC not required); and
- o Rural Polytechnical Institute, Katibougou (Kankaboro). About 600 students for the technical course, entitled through the DEP (BEPC) and about 400 students for the engineering course, entitled through high school graduation.

g. Ministries engaged in agricultural training

The Ministries responsible for agricultural training include:

- o Ministry of Rural Development;
- o Ministry of Agriculture;
- o Ministry of State Responsible for Equipment;
- o Ministry of Transportation and Public Works;
- o Ministry of Works;
- o Ministry of Information and Telecommunications; and
- o Ministry of Health.

## C. Notes on Administration and Economics

### 1. National budget

The 1978 national budget is presented in Table 2. For 1979 the total budget was FM 70,102,000, for 1980 FM 77,800,00, and for 1981 FM 85,180,000.

### 2. Brief description of government structures

#### a. Principal structures

The Republic of Mali gained its independence on September 22, 1960. The present constitution dates from 1974. The president of the Republic is the chief of state, head of government and holder of executive power. Only one political party exists: the Democratic Union of the Malian People (UDPM). Legislative power is entrusted to an assembly composed of 82 members, elected in 1979 for a four-year period. Judicial power lies with the Supreme Court, headed by the president and composed of 19 members appointed for five-year terms. The Special Court for National Security is made up of four magistrates, 22 members of the army, three regional governors and the Court of Appeals.

Principal government departments are:

- o National Defense Department;
- o Foreign Affairs and International Cooperation Department;
- o National Education Department;
- o Ministry of State for the Economy and Planning;
- o Ministry of Planning; and
- o Ministry of Finance.

#### b. Major policies affecting agriculture or agricultural research

Most are included in the Five-Year Development Plan (1981-85). Under this plan, rural development is allotted one-third of the financial resources.

- o Priority to increasing agricultural productivity;
- o Food self-sufficiency with a surplus for export;
- o Price policies encouraging agricultural production;
- o Enhancement of soil fertility;

Table 2: National Budget, 1978  
(estimated figures in millions of Mali francs)

<u>Revenue</u>		<u>Ordinary Expenditures</u>	
Direct taxes	15,350	Personnel	29,720
Indirect Taxes (customs, etc.)	29,780	Infrastructure	11,710
Stamps and Other	2,040	Contributions	8,420
Land Revenues	620	Regional Budgets	<u>6,670</u>
Government Corporations	200	Total Ordinary Exp.	56,520
Other Revenues	780	Capitalization	<u>4,970</u>
Previous Year's Revenue	2,100	Total	<u><u>61,490</u></u>
Regional Budget	<u>5,620</u>		
Total Ordinary Revenue	56,490		
Non-recurring Revenue	<u>5,000</u>		
Total	<u><u>61,490</u></u>		

Total Budget - 1979: 70,102 million francs

1980: 77,800 million francs

1981: 85,180 million francs

- o Environmental protection to preserve forests and permanent grazing lands and to encourage reforestation;
- o Improved river basin and lakeland area management through water-use rationalization;
- o Use of the Agricultural Credit Bank to provide farmers with basic input materials;
- o Increased livestock raising;
- o Development of small herds for fattening;
- o Increase in fisheries;
- o Development of poultry farming; and
- o Reforestation.

c. International organizations

Mali is a member of the following international organizations:

- o The United Nations (UN) and its associated agencies;
- o The Senegal River Development Organization (OMVS-Organization pour la mise en valeur du fleuve Sénégal);
- o The Organization for African Unity (OUA-Organisation de l'unité africaine);
- o The Liptako-Gourma Integrated Development Authority;
- o The West African Economic Community (CEAO-Communauté économique de l'Afrique de l'Ouest);
- o Associated Member European Economic Community;
- o The Economic Community of West African States (ECOWAS-Communauté économique des Etats ouest-africains);
- o The African Development Bank (BAD-Banque africaine de développement);
- o The Niger River Basin Authority;
- o The Movement of Non-Aligned Nations; and
- o Permanent Inter-State Committee for Drought Control in the Sahel (CILSS-Comité permanent inter-états de lutte contre la sécheresse au Sahel).

### 3. Economic information

#### a. General index

The Gross Domestic Product (GDP) for 1976 is shown in Table 3. The per capita GNP was US\$190 in 1981. The annual increase in real value in GNP per capita between 1960 and 1980 has been 1.4 percent.

#### b. International trade

Imports and exports for the five-year period 1976-1980 are shown in Table 4.

The principal imported products are foodstuffs, machinery, vehicles, gasoline, pharmaceuticals, and textiles. Principal suppliers are France, Ivory Coast, Senegal, China, West Germany, Cuba, USSR, and the United States.

The principal exports are meat, livestock, cotton, fish, groundnuts, and leather. Principal customers are France, West Germany, Great Britain, Ivory Coast, China, and Senegal.

#### c. Finances and currency

The Malian franc is worth .01 French francs. The exchange rate with the U.S. dollar over the past 12 months is presented in Table 5. The international assets, at end of 1980, are given in Table 6.

Mali's major banks are:

- o The Mali Central Bank (BCM-Banque centrale du Mali), capital: 1,000 billion FM, administered jointly with France;
- o The Mali Development Bank (BDM-Banque de développement du Mali), capital: 5,000 billion FM. The chairman is the Minister of Finance;
- o The Mali Credit and Savings Bank (BMDC-Banque malienne de crédit et de dépôts), which replaced Credit Lyonnais in 1961;
- o The International Bank for West Africa (BIAO-Banque internationale pour l'Afrique de l'ouest, Mali), a branch of the French bank;
- o The Central Savings Bank of Economic Cooperation, a French development agency;
- o The Libyan-Malian Arab Bank (BALIMA-Banque arabe lybio-malienne); and
- o The Bank of Africa.

Table 3: Gross Domestic Product, 1976  
(millions of Mali francs)

<u>Primary Sector</u>		<u>Percentage of Grand Total</u>
Agriculture	53,900	19
Traditional Sector	43,700	
Modern Sector	10,200	
Livestock	43,800	15
Forestry	5,500	2
Fisheries	<u>7,100</u>	<u>3</u>
Total Primary Sector	110,300	39
<u>Secondary Sector</u>		
Energy	3,400	
Handicraft Manufacturing	31,500	
Construction and Public Works	<u>12,800</u>	
Total Secondary Sector	47,700	16
<u>Services Sector</u>		
Transportation	11,800	
Commerce	70,000	
Public Administration	36,200	
Other Services	<u>11,300</u>	
Total Services Sector	130,000	45
Grand Total	<u>288,000</u>	

Table 4: Imports and Exports  
(millions of Mali francs)

	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>
Imports	71,500	78,000	128,600	152,900	176,300
Exports	<u>41,123</u>	<u>61,220</u>	<u>52,400</u>	<u>62,700</u>	<u>74,200</u>
Deficit	30,377	16,780	76,200	90,200	102,100

Table 5: Exchange Rate With U.S. Dollar  
(in Mali francs)

<u>1982</u>	<u>Exchange Rate</u>
September	706
October	614
November	720
December	684
<u>1983</u>	
January	678
February	688
March	702
April	732
May	756
June	766
July	778
August	804



Table 6: International Assets, end of 1980  
(million dollars)

<u>Type of Asset</u>	<u>amount</u>
International Reserves	15.4
Exchange	7.7
IMF Contingent	51.7
Banks:	
Credits	21.1
Debits	38.5

d. Economic plan in operation

The 1981-85 Five-Year Plan is currently in operation. General priorities are: to increase agricultural productivity and build an independent, planned national economy; to augment per capita income through economic planning designed to attenuate the effects of climatic vagaries; and to achieve food supply self-sufficiency during the decade. Goals directly affecting agriculture are:

- o Food supply self-sufficiency. Food supply figures are shown in Table 7;
- o Soil improvement through a managed program;
- o Protection and enhancement of permanent grazing lands;
- o Campaign against desertification; and
- o Livestock raising. The goal is to bring stock back up to the 1976 levels and thus counteract the effects of the drought. It is desirable to build up to 4,080,000 cattle, 4,219,000 sheep, 3,929,000 goats, and 10,000,000 fowl. This is to be done through development of Sahelian grazing lands, pasturage and watering-place improvement (in the Niore, Gao, Segou, Mopti and Tienfala rich pasture-land operations), and by establishing abattoir and cold storage facilities.

The overall financial picture (millions of FM) is depicted in Table 8. According to plan, the rural economy would receive 32 percent of the funds over the five-year period. The percentages would range from 31 percent in 1983 to 35 percent in 1984 and 44 percent in 1985.

e. Foreign aid including food

Assistance from international agencies is shown in Table 9.

World Food Programme (WFP) aid was requested by the government of Mali in a number of areas: rural development, the highway network and the development of natural resources. This WFP assistance proved valuable in these fields in connection with Project 2231 (1976-80) and Project 2231 (1980-83).

Over the next three years, government cooperation with the WFP will be continued under WFP Project 2231, Phase II.

This WFP aid over the coming three years will generally be devoted to supplementing wages for workers in the agricultural development, community development, timber resources and highway network areas. Food assistance needs during the next three years amount to approximately 72,381,550 rations costing US\$31,166,900.

Table 7: Food Supply Figures  
(tons)

	<u>1981</u>	<u>1985</u>
National Grain Requirements (millet, sorghum, rice paddy, maize, wheat, fonio)	1,266,000	1,435,000
Production Forecast	<u>920,000</u>	<u>1,323,000</u>
Deficit	346,000	112,000

Table 8: Financial Forecast  
(millions of Mali francs)

<u>Sectors</u>	<u>Five-Year Plan</u>	<u>Financing</u>		<u>Plan</u>	<u>Plan</u>	<u>Plan</u>
		(percentage)		<u>1983</u>	<u>1984</u>	<u>1985</u>
		<u>Dom.</u>	<u>For.</u>			
Rural Economy	303,000	20	80	67,000	74,000	78,000
Secondary Sector	293,000	8	92	74,000	52,000	29,000
Infrastructures	254,000	13	87	55,000	64,000	48,000
Human Resources	<u>85,000</u>	<u>22</u>	<u>78</u>	<u>18,000</u>	<u>21,000</u>	<u>23,000</u>
Total	<u>937,000</u>	<u>14</u>	<u>86</u>	<u>214,000</u>	<u>211,000</u>	<u>178,000</u>

Table 9: Assistance from International Agencies  
(million dollars)

	<u>1980</u>	<u>1981</u>	<u>1982</u>
IFC			2.6
IDA	8.0		
AFDB	13.4		25.6
UNDP	1.6	.9	.9
Others	—	.6	8.8
Total	<u>23.0</u>	<u>1.5</u>	<u>37.9</u>

- Assistance from OECD countries

	<u>1980</u>	<u>1981</u>
France	45.0	65.7
West Germany	27.0	36.0
United States	23.0	18.0
Canada	12.8	11.2
Holland	12.5	6.3
Others	<u>11.5</u>	<u>11.8</u>
Total	<u>131.8</u>	<u>149.0</u>

- Assistance from OPEC countries

<u>1980</u>	<u>1981</u>
17.3	-

- Assistance from Communist block countries

	<u>1980</u>	<u>1981</u>
USSR	-	5
PRC, Rumania, Bulgaria, Yugoslavia, North Korea, Cuba	-	-
	<u>-</u>	<u>5</u>

## D. Rural Sector

### 1. Natural resources (soil, water, climate) affecting agricultural development

The total land available for agriculture, some 46 million ha can be broken down as follows: 9.4 million ha lying fallow, 2.1 million ha under cultivation, 1.1 million ha of timberland reserves, 3.3 million ha of wildlife reserves, and 30.0 million ha reserved for grazing.

The climate is of the Sudano-Sahelian type, marked by a regular succession of seasons -- a dry season from November to May, with winds from the north, blowing especially hot from March to May, and a rainy season from June to October, when moisture is borne by winds from the Atlantic.

### 2. Agriculture land

Arable land in 1981 was 2,047,000 ha, permanent pasture land some 30,000,000 ha, and irrigated areas 7,100,000 ha. The land areas devoted to various crops are shown in Table 10.

### 3. Land tenure

There are four bases for the land tenure system:

- o Non-legal, sacred nature: The tradition under which land has a mystical value and cannot be acquired by appropriation or transfer in the legal sense. Operation is usually on a collective basis. When property use has been the responsibility of a specific lineage, conveyance must take place within this same lineage. Anyone, however, is free to make use of non-assigned lands;
- o Islamic influences: Although Islam rejects the sacred nature of land, no effort has been made to alter established rights. Thus, in the central delta region 19th Century custom still governs land right-of-way and pasturage;
- o System before independence: Colonial legal procedure governing property rights are basically confined to the urban areas; and
- o Legislation since independence: Legislation in modern-day Mali has tended to support government land rights, extending to abolition of traditional rights in hydro-agricultural development areas. Reforms are required to bring all land legislation into line with existing rural, forestry, hunting and livestock statutes.

Table 10: Land Areas Devoted to Various Crops  
(ha)

<u>Crop</u>	<u>1979</u>	<u>1980</u>	<u>1981</u>
Millet	1,400,000	1,400,000	1,420,000
Groundnuts	200,000	200,000	207,000
Rice (paddy)	160,000	140,000	172,000
Cotton	109,000	121,000	121,000
Maize	90,000	90,000	90,000
Vegetables	125,000	130,000	135,000
Root Crops	12,000	12,000	12,000
Pulses	32,000	32,000	33,000
Sugar Cane	3,000	5,000	3,000
Others	-	-	-

#### 4. Principal crops

In order of importance, Mali's principal crops are millet (with sorghum and fonio), rice, groundnuts, vegetables, cotton, corn (maize), pulses, root crops, and sugar cane (see Figure 10). Details are given in Table 11.

#### 5. Principal livestock products

Figures for livestock products are shown in Table 12.

#### 6. Forestry

In 1982, timber yield was FM 595,683,830, compared with FM 493,600,718 in 1981. A fee is required from users of forest resources for hunting and fishing purposes.

Cordwood furnishes some 95 percent of domestic energy. In urban areas, per capita consumption is approximately 1.8 steres (cubic meters) a year, amounting to an annual total of 11,700,000 steres. In 1982, the quantity used and checked was 466,569 steres, about 3.98 percent of actual total consumption (1981-487,202 steres). These amounts do not include OAPFF and OARS figures.

Charcoal consumption for the Bamako district is estimated at 5.5 kg per capita annually. In 1982, total quantity checked was 57,265.4 quintals (100 kg measures), compared with 43,265.5 quintals in 1981.

Lumber production figures for 1982 are shown in Table 13.

Timber (general purpose) production figures for 1982 are shown in Table 14.

Principal products harvested are karite almonds and gum arabic for which there is a considerable international trade. Figures supplied by the Agricultural Department Processing Division show an increase in gum arabic activity (182.9 tons in 1981 to 297.3 tons in 1982) and a decrease in karite almond trade (from 8,023.02 tons in 1981 to 3,282.54 tons in 1982).

Estimates put the country's total cordwood (firewood) requirements at 1.7 million tons per year, with 17 percent for the needs of the urban population. This consumption is estimated on the basis of 360 kg per capita in urban regions and 270 kg in rural areas. Charcoal represents some 10 percent of consumption, and an equivalent amount is used in construction stakes and poles. Some species provide fruits and fodder. Two sectors are especially vulnerable. Natural woodland growth is retreating under the pressures of rapid population growth in the Bamako urban region, and wood consumption is estimated at 200,000 tons annually in that region, a demand which is becoming increasingly difficult to meet. The situation is even more serious in the Mopti area, because of the wood and charcoal quantities required for the fish smoking process. Supply lines are growing longer and prices are rising. Since 1972, the Forestry Development and Produc-





Table 11: Principal Crops

Crops	Total Area 1981 (000 ha)	Total Production 1981 (000 mt)	Annual Production Value (billion Mali francs)	Average Yield 1981 (kg/ha)	Producer Price (f/kg)	Consumer Price (f/kg)	Regions								River Region	Bamako
							Gao	Kayes	Koulikoro	Sikasso	Segou	Mopti	Timbuktu			
Millet (including sorghum & fonio)	1,420	930	60	500 to 700	19 in 1970 40 in 1979 85 in 1981	132 to 250	x	x	x	x	x	x	x			
Rice (paddy)	172	150	8.5	800 to 1,000	25 in 1970 50 in 1979 80 in 1982 (average price for red, mixed & white paddy)	270 to 320				x					x	
Groundnuts (unshelled)	207	190	13	600 to 900	30 in 1970 60 in 1979			x							x (Lower Delta)	
Vegetables	60	135					x	x	x	x	x	x	x		x	
Cotton (seed)	121	114	11.5	900 to 1,300	48 in 1970 90 in 1979					x						
Maize	90	80	40	600 to 900	19 in 1970 40 in 1979 90 in 1982	132 to 250		x	x	x		x				
Pulses	33	36		1,000 to 1,100		350 to 650	x	x	x	x	x	x	x		x	
Root Crops (manioc, sweet potatoes)	12	116		8,500 to 9,500		300 to 400	x	x	x	x	x	x	x		x	
Sugar Cane	3	225		60,000 to 75,000							x					

Table 12: Principal Livestock Products

<u>Product</u>	<u>Total Volume (mt)</u>	<u>Total Value (million Mali francs)</u>	<u>Consumer Price Mali francs (kg) (liter)</u>		<u>Number of Heads (000)</u>	<u>Rate of Increase (percentage)</u>	<u>Rate of Use (percentage)</u>	<u>Average Carcass Weight (kg)</u>	<u>Annual Per Capita Consumption (kg) (liter)</u>	
Beef	46,482	60,426.6	1,100 (1981) 1,300 (1983)		5,124	3.7	12	150	6.5	-
Sheep and Goat Meat	53,945	97,101	1,500 (1981) 1,800 (1983)		10,311	4	30	15	7.6	-
Cow's Milk	102,000	40,800	-	350 to 500	-	-	-	-	-	14
Sheep and Goat Milk	74,000	25,900	-	350	-	-	-	-	-	10
Poultry	11,000	-	1,750	-	12,500	6.5	8.8	1	1.5	-
Eggs	9,000	-	150	-	-	-	-	-	1.75	-
Pork	7,000	7,000	1,000	-	-	-	-	-	-	-
Hides										
Cattle	7,067	-	-	-	-	-	-	-	-	-
Sheep	5,170	-	-	-	-	-	-	-	-	-
Goats	3,360	-	-	-	-	-	-	-	-	-
Honey	300	-	-	-	-	-	-	-	-	-
Wool	330	-	-	-	-	-	-	-	-	-

Table 13: Lumber Production Figures  
(feet)

<u>Type</u>	<u>1981</u>	<u>1982</u>
Kapokwood (bonbax constatam)	-	757
Isoberlivia Doka (San)	574	641
Dougoura (cordyla primata)	-	422
Cailcedrat (Khaya senegalensis)	82	196
Pvene (pterocarpus erinaceus)	270	132
Lingue (Afzelia africana)	-	16

Table 14: Timber  
(m<sup>3</sup>)

<u>Type</u>	<u>Quantity</u>
Palmyras (palms)	950
Doum (doom) Palms	1,820
Perches and Fourches	21,714
Fourchettes	122,923
Goulettes	32,579
Rachis (racemes)	44,504
Bamboos	26,948

tion Operation (OAPF-Operation aménagement et production forestière) has been responsible for the task of developing an 18,000 ha reforestation area over a 30-year period, mainly to meet the cordwood and construction lumber needs of the large urban centers. This project complements the 1,500 ha of gmelina, teak, neem and eucalyptus plantations already in use. A vigorous reforestation policy, however, has still to be developed.

## 7. Fisheries

Only partial statistics are available. Some figures are supplied by the Mopti Fisheries Operation, but none exist for other fishing activities. Total volume from 1975 to 1981 (FAO figures) was 100,000 tons in the "miscellaneous fresh water fish" classification. Drying or smoking permits preservation of a large part, some 70 percent, of production. Salt is also used in preservation. Exports according to FAO figures were 4,405 tons, and according to Mali figures, 10,000 tons. Total value in 1981 was \$4 173,000. Annual per capita consumption was 15 kg, but this quantity is often less because of dried fish losses due to insects. The current consumer price in Bamako was 700 to 1,500 FM/kg.

## 8. Principal farming and livestock systems

Agriculture employs 87 percent of the active population and accounts for only 42 percent of the GNP. Most farmers use traditional farming methods, and the bulk of the crops are for subsistence consumption.

These traditional methods involve the use of the hoe and the restoration of the brush soils through long fallow periods. Farmers make use of every available bit of land — kitchen gardens, village manured land, brush fields, lowlands and flood-recession land. With this large degree of diversity in methods, they endeavor to reduce the element of risk due to climatic uncertainty and crop damage caused by blight, insects and animal pests. In some areas, more complex production methods are employed, such as on the highlands and slopes of the Dogon Plateau and in the large Sikasso lowland areas. There is considerable out-of-season crop production, e.g., the Dogon Plateau onions (shallots) and the Sikasso region potatoes and bananas.

Development operations include attempts to introduce modern methods such as fertilizer, animal traction, phytosanitary products (e.g., for cotton); and new crops (cotton, kenaf, sugar cane, tea, tobacco) and improved sowing practices. The most marked success has come in the operations of the Mali Textile Development Company (CMDT-Compagnie malienne de développement des textiles) in the cotton and kenaf areas, in some rice operations (Sikasso) and in the production of some cereals in their region. Farmers have been able to replace traditional methods with more efficient ones, so that their products, destined for the marketplace, surpass by far the surpluses achieved under traditional farming.

A start has been made in developing a genuine mixed farming system, using animal traction and raising cattle and sheep, which graze on cropland by-products, while supplying manure.

Karite (*butyre-spermum parkii*) nut harvest in the Sudanese region is destined for karite butter production for local consumption as well as export.

Three systems of animal husbandry existed in Mali. The first, the great nomadic tribes of the Sahara with their herds of cattle, camels and sheep, is disappearing. The second, transhumance, is the predominant system today. The delta of the Niger River acts as a lung; after the river flooding subsides, the livestock enter the uncovered land up-river from the delta and then descend down-river as the borgou is uncovered. In July, the animals are dispersed toward the winter grazing grounds and the delta is flooded once again.

The third animal husbandry system is the sedentary system. The sedentaries entrust their livestock to the Peuls, and at the beginning of the cultivation season, the Peuls herd most of the sheep to prevent damage to the fields. Following harvest, the animals return to the villages.

The southern and western areas are infested with glossina contaminated by trypanosomiasis. The zebus are susceptible to disease but the meres (a cross-breed between the zebu and the taurin) are trypanotolerant. In the infested areas, cattle tolerant to trypanosomes are raised.

#### 9. Market systems

These systems deal with millet (small millet, sorghum, and fonio).

For millet and sorghum there are two channels: the official channel and an unofficial private channel. The quantity marketed is, on average, 15 percent of production.

The official commercial channel runs through state organized operations: OPAM. The product is channeled on a priority basis, first to state officials, and then to others, depending on the quantity available at that price.

In the past, each region, sub-sector and village had a quota to deliver at given prices to the producers ("compulsory delivery" in the socialist countries of Eastern Europe). That is in essence a revenue transfer from the producers to the state officials and other city dwellers.

The remainder, about 75 percent of the marketed quantity, is channeled through village markets, then through collective markets, and finally through markets in the principal urban centers. In general, commercial expenses are less in the private sector than in the public sector. The quantity in the private sector is not well defined but is certainly greater than in the public sector.

Vegetables, root plants and tubers are marketed in the private sector.

The groundnut operation (ODIPAC) endeavors to collect groundnuts to supply the oil mills at Koulikoro (SEPOM) and Kita (SEPAMA) which are operating under capacity. These oil mills supply the domestic and export markets.

At the same time, a continually increasing quantity of groundnuts are sold on the private market for consumption by the rural and urban populations.

Rice paddy is also channeled through both public and private markets. There are both public and private rice processing plants. In projects such as the Niger Office, attempts are being made to require producers to market their harvests through the public system. In the Sikasso region, a large portion of the rice crosses the borders.

The maize market is divided between the public and private sectors. The private sector also markets a significant quantity of corn on the cob.

The collection of cotton takes place at the village level through producer groups organized by CMDT. The operation is responsible for transport to the processors and most of the product is intended for export. The rest is used for thread spinning and by the textile industry.

A small quantity of cotton is channeled through the village markets to meet the needs of women who spin cotton thread. A portion of the supply to artisan weavers moves through this channel.

Cowpeas are marketed through the private sector.

The market of Karite nuts and butter is significant on the domestic and export markets. Part of the karite is channeled through the oil mill at Koulikoro.

Trade in ruminants occurs through a system of local markets, collective markets and terminal or export markets. There are also bush collectors who collect animals in the bush and take them to local markets.



The system depends on the private sector with government control through the Malian Office for Livestock and Meat (OMBEVI). In the markets, an extensive system of intermediaries, brokers, etc., assumes these functions.

Animals to be slaughtered are bought by wholesale butchers; the meat and meat products are then sold to retailers. The hides are bought by specialized merchants. Animals to be exported are sold in the large livestock markets (Kati, Segou). Collection is carried out by merchants for export by truck to neighboring countries.

Milk is marketed by producers' wives, principally among the Peuls. Attempts have been made to collect milk to supply a plant (Malilait), but the collection process is uneven throughout the year, and the price of milk varies from one month to the next. The difficulties in collection and variations in the price of milk led to the use of powdered milk to supply the plant.

Eggs and poultry are marketed by the private sector. They are sold in all the villages and urban markets. The Mali poultry farming operation in Sotuba markets parts of its eggs and poultry in Bamako.

Most of the fish (70 percent) are dried or smoked, which allows them to be stored and transported from the fishing areas to the consumer areas. Immediately upon reaching the river's shore, the fishermen sell their fish to merchants and to specialists who dry or smoke the fish. The specialists resell the dried or smoked fish to merchants who arrange for transport to the consumer markets.

#### 10. Factors of production

Mali possesses a number of phosphate deposits, particularly in Tilemsi (near Gao). This deposit is being mined and the production is pulverized at Markala for the Niger Office, which is the largest consumer (2,000 metric tons in 1979).

Although these phosphates are less soluble than the tricalcium phosphates, they are still of good quality for irrigated areas or areas with sufficient rainfall (i.e., more than 800 mm). Between 1975 and 1980, Mali imported manufactured fertilizers with an average annual value of US\$5.74 million. A significant portion of these imports were for the Cotton Operation (20,000 metric tons per year 1978-80). In 1981, the price of fertilizer rose, while the price of cotton remained unchanged. This caused a drop in consumption to 13,000 metric tons. OACV has distributed 1,800-2,500 metric tons per year.

The principal indigenous agricultural tools are short-handle hoes (the daba). They take several forms depending on the use and the region. Most of these tools are manufactured locally.

CMDT imported a few dozen 25 hp tractors to test with selected farmers. Because this experiment proved rather successful, the imports are continuing on a modest scale. Animal-drawn agricultural machines are manufactured or assembled at Bamako by SMECMA and are sold by SCAER. More than 38,000 harness rigs were sold between 1973 and 1979.

#### 11. Ministries dealing with agriculture

At the governmental level, two ministries share responsibility for the rural sector: the Ministry of Agriculture and the Ministry of Rural Development. The latter coordinates the activities of the Ministry of Agriculture.

##### a. Ministry of Agriculture

This ministry is responsible for agriculture in the strict sense of the term. It heads up two national administrations, one for agriculture and the other for rural engineering, and a number of associated services which benefit from a substantial degree of autonomy, including the Institute for Rural Economics (IER-Institut d'économie rurale). Also associated with the Ministry of Agriculture are a number of separate legal entities which are in fact more or less autonomous public establishments directly responsible for development in a determined sector or area. There are essentially 15 operations, among which the two most important are the Niger Office (ON) and the Malian Company for the Development of Textiles (CMDT-Compagnie malienne pour le développement des textiles).

##### b. Ministry of Rural Development (MDR-Ministère chargé du développement rurale)

Previously known as the Ministry for Livestock, Water and Forestry, this ministry is responsible for these two rural sectors and also coordinates the activities of the Ministry of Agriculture. It heads up four national administrations: Livestock, Water and Forestry, Cooperation and Training for Rural Activities and Associated Services, including the National Institute for Animal Husbandry, Forestry and Hydrobiological Research (INRZFH-Institut nationale de la recherche zootechnique, forestière et hydrobiologique) and the Central Veterinarian Laboratory (LCV-Laboratoire central vétérinaire). Separate legal entities, such as the Operation for Livestock Development in the Mopti Region (ODEM-Opérative de développement de l'élevage dans la région de Mopti) or the Dairy Union of Bamako (ULB-Union laitière de Bamako) are associated with this ministry.

#### 12. Nutritional summary

Principal foods produced in the country are presented in Table 15. Per capita daily consumption between 1978-1980 was 1,996 calories -- of 54.9 grams proteins (of which 75 percent are vegetable protein), 40.9 grams of fats (of which 75 percent are vegetable fat), and 352.1 grams of carbohydrates. Table 16 indicates the principal foodstuffs imported and exported in 1979, 1980 and 1981.

Table 15: Food Production  
(000 mt)

	<u>1979</u>	<u>1980</u>	<u>1981</u>
Cereals, Total	1,236	955	1,204
Wheat	2	2	2
Rice equivalent	106	75	85
Maize	85	33	80
Millet/Sorghum	922	750	930
Others	50	45	50
Root Plants and Tubers	113	115	116
Pulses	35	35	36
Groundnuts in shell	179	130	190
Vegetables (melons not included)	125	130	135
Fruits (except melons)	9	9	10
Sugar (raw centrifuged)	16	18	20
Meat, Total	118	118	120
Beef/Veal	38	37	38 <sup>a</sup>
Mutton/Lamb	23	24	25 <sup>a</sup>
Goat	21	21	22
Pork	7	7	7
Poultry	10	11	11
Others	19	18	17
Milk, Total	125	160	176
Cattle	96	88	102
Sheep	39	41	42
Goat	30	31	32

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<sup>a</sup>The OMBEVI estimates 1981 production at 46,482 tons of beef and 53,945 tons of mutton/goat meat.

Table 16: Principal Food Imports and Exports,  
1979, 1980, 1981  
(000 mt)

<u>Imports</u>	<u>1979</u>	<u>1980</u>	<u>1981</u>
Cereals, Total	40.1	89.7	101.6
Wheat	15.7	30.6	46.1
Rice	24.4	53.1	23.5
Maize	-	6.0	32.0
Milk, Total	32	17	19
Sugar	15.7	24.4	32.6
<u>Exports</u>			
Cattle (head)	152	225	250 <sup>a</sup>
Sheep/Goats (head)	330	307	319 <sup>a</sup>
Processed and Preserved food	0.2	0.1	0.4
Groundnuts			
Oil	6.8	4.3	9.0
Cake	12.0	10.3	8.6
Hulled Nuts	7.5	2.0	2.5

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<sup>a</sup>The OMBEVI estimates that 370,000 head of cattle and 465,000 head of sheep and goats were exported in 1981.

### 13. Agricultural credit

The agency currently in charge of agricultural credit is BNDA (National Bank for Agricultural Development). SCAER had to sell the inputs at subsidized prices without subsidy payments from the government. This meant that SCAER lacked the funds necessary to provide agricultural credit. At the same time, SCAER had some problems controlling the inventory of inputs and some financial losses resulted (BNDA and the Corn Project).

### 14. Institutions involved in agricultural research

The principal institutions involved in agricultural research are as follows:

- o Institute for Rural Economy (IER-Institut d'économie rurale);
- o National Institute for Animal Husbandry, Forestry and Hydrobiological Research (INRZFH-Institut nationale de la recherche zootechnique forestière et hydrobiologique);
- o Katibougou: Rural Polytechnical Institute (IPR-Institut polytechnique rural);
- o Mopti Hydrobiological Laboratory (LHM-Laboratoire d'hydrobiologie de Mopti);
- o Central Veterinarian Laboratory (Animal Health) (LCV-Laboratoire centrale vétérinaire);
- o Office for Overseas Scientific and Technical Research (OSTOM-Office de la recherche scientifique et technique outre-mer);
- o Semi-Arid Food Grain Research and Development (SAFGRAD);
- o International Institute for Research on Cereals in Tropical, Semi-arid Zones (ICRISAT-Institut internationale de recherche sur les céréales en zone tropicale semi-aride);
- o International Livestock Center for in Africa (CIPEA-Centre internationale pour l'élevage en Afrique);
- o Common Organization for the Control Bird and Insect Predators (OCLALAV-Organisation commune de lutte antiacridienne et de lutte antiaviaire); and
- o International Organisation for Locust Control (OICMA-Organisation internationale contre le criquet migrateur).

The operations for agricultural development are:

- o Malian Company for Textile Development — Southern Mali (cotton, kenaf, rice, tea) (CMDT-Compagnie malienne pour le développement des textiles -- Opérations Mali-sud (coton, kenaf, riz, thé);
- o Office of Integrated Development for the Production of Groundnuts and Cereals (ODIPAC-Office de développement intégré pour les productions arachidières et céréalières);
- o Kaarta Operation for Integrated Development (millet) (ODIK-Opération de développement intégré du Kaarta (mil));
- o High Valley Operation (tobacco, cotton, groundnuts and rice) (OHV-Opération haute-vallée (tabac, coton, arachide, riz));
- o Mopti Rice Operation;
- o Mopti Millet Operation;
- o Niger Office (Sugarcane, Rice);
- o Wheat Operation, Dire, Doundam;
- o Rice Action, Segou; and
- o Baguineda Operation for Integrated Development (ODIB-Opération de développement intégré de Baguineda).

Development operations for livestock are:

- o Operation for the Livestock Development (ODEM-Opération développement de l'élevage);
- o Southern Mali Project; and
- o Western Sahel Project.

The operations covering forestry development are:

- o Operation for Forestry Development and Production (OAPF-Opération aménagement et productions forestières);
- o Operation for the Development and Reforestation of Sikasso (OARS-Opération aménagement et reboisement de Sikasso); and
- o National Park Operation for la boucle du Baoule (OPNBB-Opération parc nationale de la boucle du Baoule).

The Mopti Fishing Operation is the only operation in the domain of fishing.

### III. AGRICULTURAL RESEARCH INSTITUTIONS

#### A. Institute for Rural Economy

##### 1. Sponsoring ministry

The sponsoring ministry is the Ministry of Agriculture.

##### 2. Mission and objectives

The IER is a service associated with the Ministry of Agriculture in charge of research, evaluation and conception, and plays a role of coordination and permanent liaison between the services or authorities charged with research, studies, organization and evaluation of agricultural development programs. (See Figure 11.)

Its mission is to conduct all studies and research for the development and enhancement of agricultural knowledge.

Specifically, it is charged with:

- o The conception, management, and completion of agricultural research programs and programs of research on systems of rural production;
- o Planning and evaluation of agricultural development projects;
- o Supervision and coordination of organizations and authorities which may be called upon to perform research and studies on agricultural development in or for Mali; and
- o The creation, conservation, and protection of the national scientific assets within its specialized area.

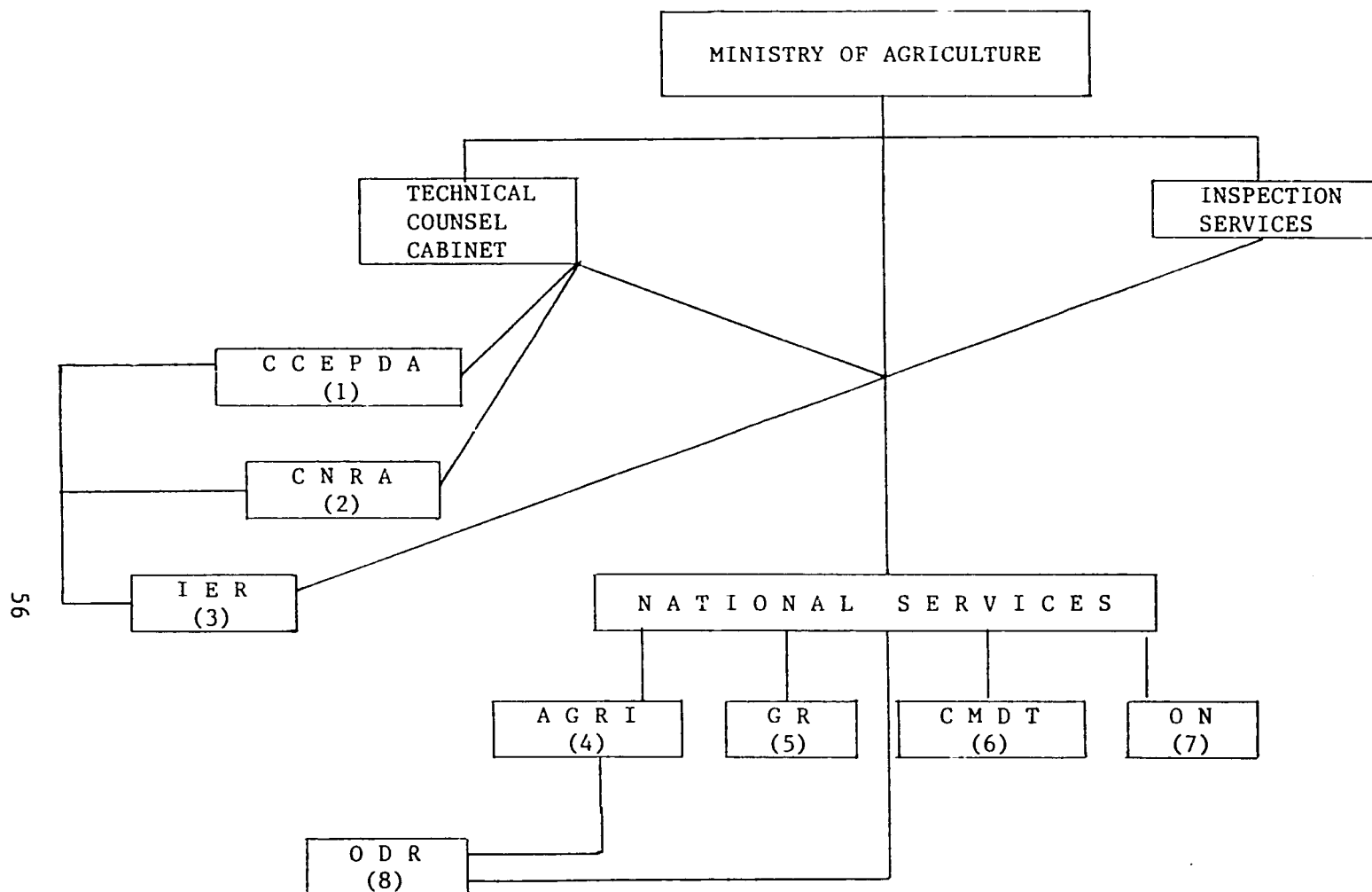
##### 3. Structure-organization of IER

###### a. Divisions

The IER operates under the authority of a director supported by an assistant. Its activities are divided among six divisions as follows:

- o Division of Agronomic Research (DRA-Division de la recherche agronomique) which has the mission of conducting experimental research on crops in Mali as well as the coordination and control of the activities of the international and regional agronomic research organizations;

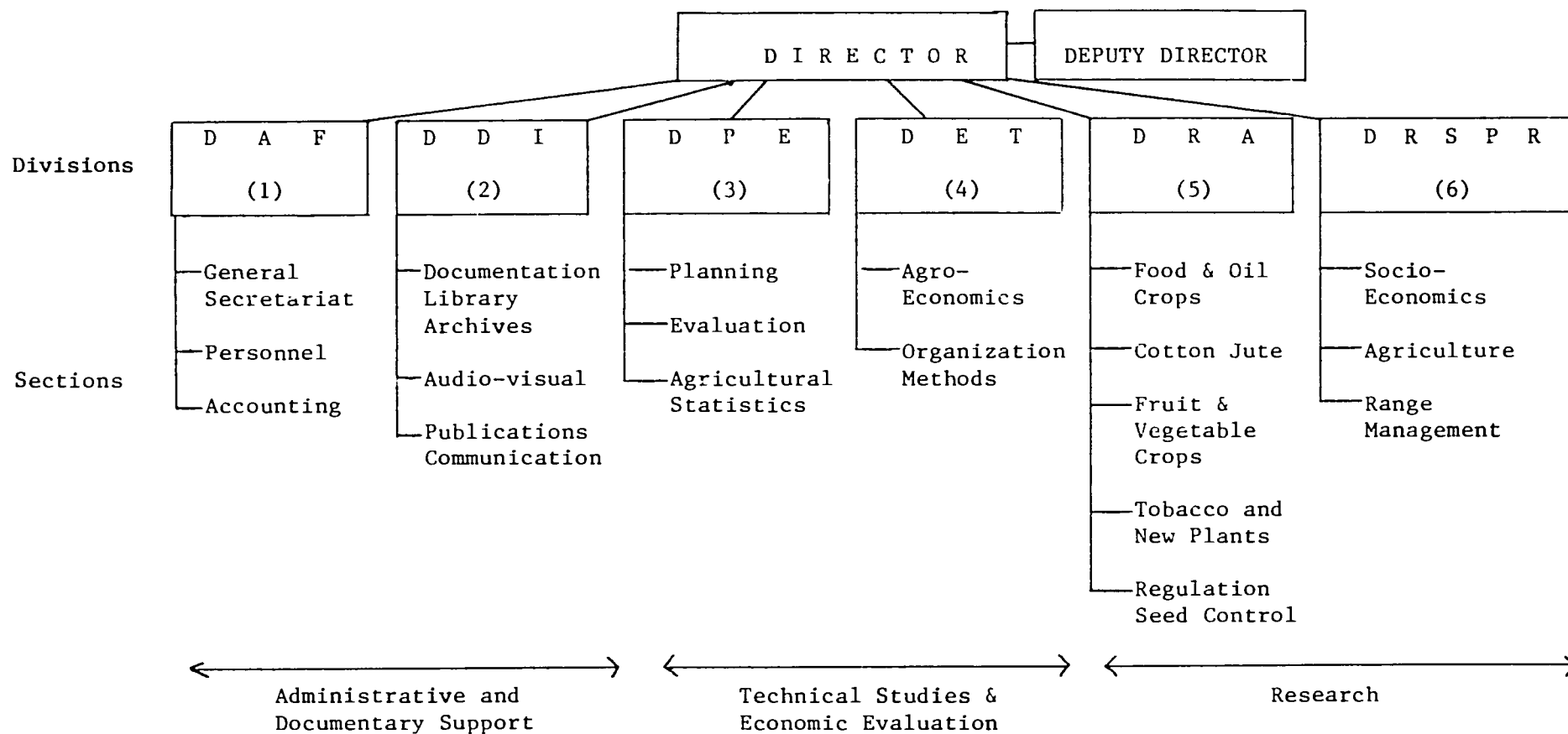
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- (1) Coordination Committee for Agricultural Development Studies and Programs
- (2) National Agronomic Research Committee
- (3) Institute of Rural Economics
- (4) National Agricultural Directorate
- (5) National Rural Engineering Directorate
- (6) Malian Textile Development Company
- (7) Niger Office
- (8) Rural Development Operations

Figure 11: Position of the Institute of Rural Economics in the Ministry of Agriculture Structure





- (1) Administrative and Financial Division (DAF)
- (2) Documentation and Information Division (DDI)
- (3) Division of Planning and Evaluation (DPE)
- (4) Division of Technical Studies (DET)
- (5) Agronomic Research Division (DRA)
- (6) Farming Systems Research Division (DRSPR)

February 1982

Figure 12: Organizational Chart of the Institute of Rural Economics

- o Division of Research on Systems of Rural Production (DRSPR-Division de la recherche sur les systèmes de production rurale) is charged with conducting multidisciplinary studies and research necessary to perfect rural production systems appropriate for each ecological zone;
- o Administrative and Financial Division, dealing with general administrative and supervision problems, management of personnel and accounting.
- o Documentation and Information Division (DDI-Division de la documentation et de l'information), dealing with problems related to documentation and the diffusion of technical information;
- o Planning and Evaluation Division (DPE-Division de la planification et d'évaluation), called upon to participate in programming production objectives, to formulate coherent strategies, and to measure the effectiveness of agricultural development projects; and
- o Division of Technical Studies (DET-Division des études techniques), with the mission of conducting basic studies on the entire range of problems related to agricultural development, and the conception of agricultural development projects with regard to their economic, agricultural and sociological aspects.

As one can observe, the IER is not solely a research organization; only two of its divisions, the DRA and the DRSPR, are charged with carrying out research. The following pages will discuss primarily the activities of these two divisions which constitute the major components of the IER.

#### b. Division of Agronomic Research (DRA)

This division conducts the agricultural research programs determined by the Scientific and Technical Committee (National Committee for Agronomic Research) which, on the basis of results obtained by the various research organizations and program projects examined and commented upon by the Specialized Technical Commissions, formulates recommendations and adopts annual or multi-annual research programs.

In this context, the Division is charged with the execution and control of agronomic research and tests on the entire range of crops cultivated in Mali as well as with the coordination and control of the activities of the specialized regional or international agronomic research organizations in Mali.

c. Research sections

Work in applied research and experimentation is conducted by five specialized sections, which are in turn subdivided into research working groups, as follows:

- o Research on Food and Oleaginous Crops (SRCVO-Recherches sur les cultures vivrières et oléagineuses);
- o Research on Cotton and Jute Fibers (SRCFJ-Recherches cotonnières et fibres jutières);
- o Research on Fruit and Garden Produce (SRFM-Recherches fruitières et maraîchères);
- o Research on Tobacco and New Plants (SRTPN-Recherches sur le tabac et les plantes nouvelles); and
- o Regulation and Control of Selected Seeds (SRCSS-Reglementation et contrôle des semences sélectionnés).

Each of the first four sections carries out the following activities in its respective, specialized field:

- o Research on varietal improvement, general agronomy (encompassing, in particular, problems related to the improvement of cultivation and manuring techniques), crop protection, and technology;
- o The production of foundation plants or seed; and
- o The control and coordination of the entire range of research programs in the concerned areas.

The fifth section (SRCSS) plays the role of controlling and regulating seed production policy in Mali.

(1) Food and Oleaginous Crop Research Section

This section deals essentially with cereals (millet, sorghum, maize, rice) and legumes (groundnut, cowpeas). In addition to the research on these species, it undertakes agropedological research on all crops cultivated in Mali. Its programs are executed at several stations, Research Support Bases (PAR-Points d'appui de la recherche) and Permanent Experimentation Bases (PEP-Points d'experimentation permanents), as well as through a multi-site experimentation network.

(2) Cotton and Jute Fiber Research Section

The programs for research on cotton and kenaf (hibiscus) are conducted by several working groups operating at the N'Tarla Station and various research support bases and permanent experimentation bases.

### (3) Fruit and Garden Produce Research Section

Research on the cultivation of fruit trees covers mangos, citrus fruit, pineapple, avocado, guava and papayas.

Research on garden produce involves tests conducted on green beans, tomatoes, onions, peppers, lettuce, cabbage, and okra.

### (4) Tobacco and New Plant Research Section

The activities of this section are divided as follows:

- o Tobacco research which is conducted on the different qualities of tobacco ordered by the National Tobacco and Match Company of Mali (SONTAM-Société nationale des tabacs et allumettes du Mali) and with a view toward eventual exports (testing new varieties and methods of cultivation); and
- o Research on new plants for which the objective is presently limited to the tea plant and which is being conducted on the outskirts of south Sikasso.

### (5) Selected Seed Regulation and Control Section

The mission of this section consists of clearing and certifying widely used seeds and regulating the production of seeds.

### d. Rural Production Systems Research Division

The Rural Production Systems Research Division (DRSPR-Division de la recherche sur les systèmes de production rurale) is charged with conducting multi-disciplinary studies and appropriate research for the improvement of agricultural production systems adapted to each of the territory's ecological zones.

The results and programs of the DRSPR, like those for agronomic research, are reviewed annually by the Scientific and Technical Committee (National Committee for Agronomic Research).

### (1) Sections

The Division is composed of three sections:

- o Socio-economic Section: conducts socio-economic studies and research on agricultural production and its environment, and studies the social and economic implications of technologies proposed to farmers as well as their effects at the local and regional levels;

- o Agricultural Section: studies technical constraints on the cultivation systems, conducts research and experiments, both at the farmer's level and in the station, and coordinates these activities with those of other research bodies from the IER and the development organizations; and
- o Pasture Land Section: conducts studies and research with the aim of proposing appropriate actions to improve the use of animal resources in the farm environment, as well as the management of pastures and natural pasture land in order to better integrate agriculture and livestock.

## (2) Areas involved

Until now the division has limited its activities to the southern zone of Mali, where it is involved in three areas:

- o Sikasso-Bougouni axis area: an investigation to categorize farms according to the technical levels (ranging from manual cultivation to small scale mechanization) has allowed the categorization of various types of farmers, while preparing future experimentation for new strategies;
- o Fonsebougou area: case studies conducted at selected farms to identify development constraints; tests and technical activities are conducted in the farm environment in order to eliminate the identified constraints on certain farms (in particular, actions necessary to improve sanitation and animal feeding).
- o Tierouala (experimentation) area: rigorous experimentation on the technical systems for animal traction and mechanized cultivation is conducted at the Tierouala station, which is under construction.

## (3) Research

Research is being conducted at principal research stations, research support bases (PAR), which are sub-stations, permanent experimentation bases (less elaborate structures) and through the multi-site experimentation network.

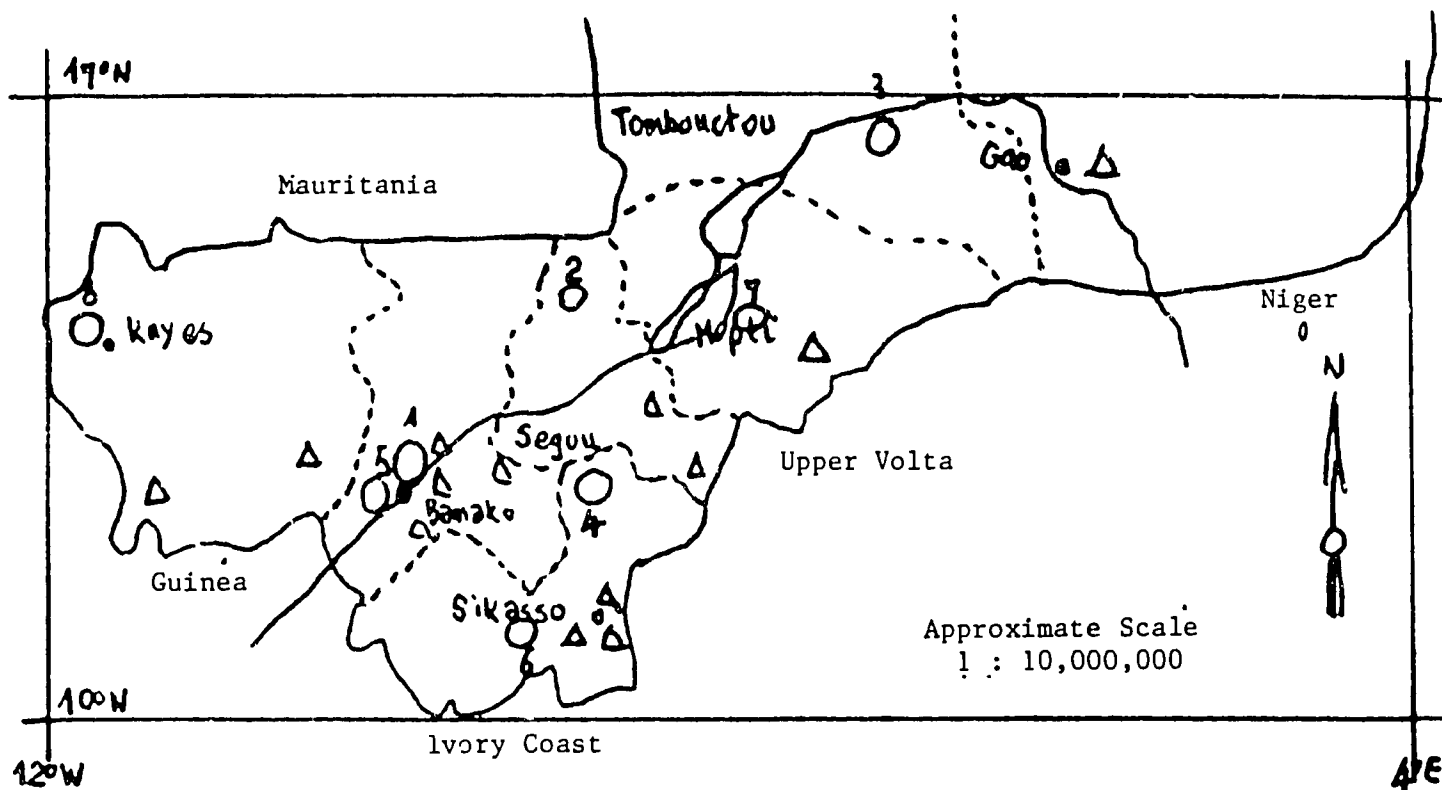
Working conditions in these research structures become more like those of the local farmers as one goes from the well-equipped stations to the permanent experimentation bases.

e. Research stations

There are seven stations for national research, complemented by two regional stations - one, the West African Rice Development Association (WARDA) in Mopti, and also the Organization for the Development of the Senegal River (OMVS-Organisation pour la mise en valeur du fleuve Sénégal) in Samé, whose management is assumed directly by these two regional organizations. Only the national stations will be discussed here. The geographic location of these research stations is shown in Figure 13.

These are:

- o The Sotuba station (west-central, near Bamako) which has its work divided among six research working groups each coordinating the entire range of programs in its specialized area throughout Mali. The six working groups deal with varietal improvements (millet, maize, sorghum, cowpeas), agropedology (fertilization, soil analysis, soil laboratory), cultivation techniques, multi-site tests, crop protection, and oleaginous plants;
- o The Kogoni station (north central, on Niger Office land, 370 km from Bamako) which deals with problems related to irrigated rice cultivation, particularly varietal improvement and the reproduction of high quality rice seed. A few tests on millet, sorghum and maize are also conducted there, in and out of season (under irrigation);
- o The Dire station (north, 750 km from Bamako) which conducts experiments on the irrigated cultivation of wheat and other rotating food crops;
- o The Kogoni station (north-central, 370 km from Bamako) which, in addition to its activities dealing principally with food crops, conducts research on irrigated cotton cultivation and tests on seed reproduction, in particular the kenaf (hibiscus);
- o The Cinzana station (north-central, 45 km from Segou) which was recently created (official inauguration was July 23, 1983) essentially oversees the working group programs on agronomy, on the improvement of millet plants, the principal crop, and to a lesser degree on sorghum, cowpeas and fonio;
- o The N'Tarla station (east-central, Koutiala Circle, 340 km from Bamako) which includes five research working groups, each coordinating the entire range of programs in its specialized area throughout Mali. For cotton, these are genetic and varietal improvement, agronomy, external experimentation, entomology, and jute fibers (kenaf).



○ - Agricultural Research Stations

- 1 - SOTUBA Grains, Oleaginous Crops, Cultivation Techniques
- 2 - KOGONI Rice, other Grains and Irrigated Cotton
- 3 - DIRE Irrigated Wheat
- 4 - N'TARLA Cotton and Jute Fibers
- 5 - BAMAKO Fruits and Vegetables
- 6 - TIERQUALA Farming Systems Research
- 7 - MOPTI WARDA Associated Project - Floating Rice
- 8 - SAME OMVS Associated Project - Grains and Pulses

△ - Annexes, Sub-stations and Research Support Bases

Figure 13: Geographical Distribution of Agricultural Research in Mali

- o The Bamako station which, with four working groups, is dedicated to fruit tree cultivation, crop protection, garden vegetable crops, and technology;
- o The Tirouala station which is involved in research on rural production systems.

f. Research support bases (PAR)

These are sub-stations and research centers which perform experiments on the conditions of the various ecological zones in Mali and the results obtained in-station. They number eight, divided as follows for food and oleaginous crops:

- o West-central: Katibougou and Samanko (groundnuts, cultivation techniques);
- o East-central: Koporokenie-Pin in the Seno (millet and food pulses) and Baramandougou (cereals and pulses);
- o West: Kita (groundnuts and cereals);
- o North-west: Bema (cereals and pulses);
- o South: Longorola (millet, sorghum, maize, rainfed rice and swamp rice); and
- o North: Tacharane, in Gao (rice, flood-recession, sorghum, wheat).

For research on the cotton plant and jute fibers, there are three bases:

- o Kolombada (west-central), cotton and rotating crops;
- o Koula (east-central), cotton and existing rotating crops; and
- o Kabila (south), cotton and newly created rotating crops.

For research on fruits and garden produce, there are four:

- o Farako-chutes substation (southeastern), various fruit trees;
- o Baguidneda PAR (west-central), various fruit trees;
- o Yanfolila PAR (south), various fruit trees; and
- o Fari/Kenieba PAR, various fruit trees.

For research on the tea plant, the Banakoni, Finkolo and Farako PARs on the outskirts of Sikasso, there is only one center, namely, the Center for the Physical Analysis of Textile Fiber at Bamako (technology of textile fibers).



g. Permanent experimentation bases (PEP)

For the SRCFJ, these are Molobala (southeast) near Koutiala, Loutana (southeast) near Sikasso, and Sikoroni (central) in the Fana region.

For the SRCVO, there is Massantola (central-west).

h. Multi-site experimentation network

Testing is conducted on several dozen bases throughout the areas related to the various sections.

4. List of current programs

At the Agronomic Research Division level the following programs exist:

- o Improvement of millet, maize, sorghum, cowpeas, and minor crops;
- o Millet. The program deals essentially with improvement of local populations for yield, improvement of the grain/past ratio, enlargement of the genetic base of the sample, and evaluation of the best ecotypes from the Malian varieties of millet;
- o Sorghum. Development of the Malian varieties of sorghum, creation of new varieties and evaluation of new germoplasm;
- o Maize. Evaluation of materials introduced (old and new) from the CIMMYT, the IRAT of the SITA/SAFGRAD and harvests in Mali. Creation of new varieties designed to improve the West African composite, in cooperation with IRAT, Ivory Coast;
- o Cowpeas. Sample development to serve as a basic gene bank for future varietal improvements. Associated crop testing on millet/cowpeas, maize/cowpeas. Tests in conjunction with SAFGRAD include yield tests on the production of improved varieties of cowpeas;
- o Minor crops and agro-physiology. Varietal tests on fonio and vandzou and prospects of wild nutritional species (panicum, brachiaria). Studies on physiological mechanisms;
- o Cereal technology. Study of the effect of the degree of hulling on the preservation of To and the characteristics of couscous. Study of the percentage of recovery after hulling of millet. Development of mixed flours;
- o Improvement of rice;

- o Rainfed and lowland rice: Study of varietal productive behavior and of the degree of tolerance to foliar periculiosis;
- o Irrigated rice: Research into varieties with short-cycle production adapted to double cropping. Initial WARDA evaluation test and coordinated tests. Work on geneological selection for the control of varietal purity;
- o Improvement of oleaginous plants: Experiments on the groundnuts and soybeans. Observations of the varietal samples of introduced plants. Free modulation varietal tests on soybeans;
- o Agronomy, pedology, cultivation techniques: Study of the technical factors of production, organic material, evaluation test of soil fertilizer fertility. Tests on cultivation systems, sowing dates, study of groundwater;
- o Sugar cane: Improvement of cultivation techniques and fertilization;
- o Crop protection: Entomology of millet, maize, cowpeas, sorghum and rice. Study of varietal resistance. Study of population dynamics. Study of the infestation rate of sugar cane stem flowers. Physiopathology of millet, sorghum, groundnuts and sugar cane; anthrax. Weeds science of millet, sorghum and rice;
- o Multi-site tests: The establishment of tests on short cycle millet, sorghum, cowpeas and rice and farmer tests on rainfed and irrigated rice;
- o Varietal improvement of the cotton plant: Selection work is underway on rainfed cotton cultivation at the N'Tarla Station, and irrigated cultivation of long silk cotton at the Niger Office. The objective is to select highly productive varieties, "glandless" varieties with high oil yields.
- o Agronomy of the cotton plant: The technical factors of production and the conditions for maintaining the fertility of the cotton plant are studied at the N'Tarla Station, then through the multi-site testing network;
- o Phytosanitary protection of the cotton plant: Technical production methods are improved to provide maximum crop yield and profitability for the producer at the N'Tarla Station and through the multi-site network;
- o Cotton fiber technology: The program aims to make the Bamako Laboratory for Physical Analysis of Fibers operational and effective;

- o Outside experimentation on cotton cultivation: The program aims to improve agronomic experimentation throughout the cotton zone (the N'Tarla Station and its support bases) in order to address the problems of local farmers, applying the results obtained in agronomy, genetics and entomology and using animal traction or mechanized cultivation methods;

The kenaf program was stopped due to a lack of financing and interest from development agencies.

- o Fruit and garden produce research: This research is being conducted primarily at the National Center for Fruit Research at Bamako and its support bases;
- o Fruit tree cultivation: This research conducted at the CNRF and its support bases in the southern Mali zone involves experimentation on cultivation techniques, particularly irrigation of fruit trees in the Sudanian zone (mango, citrus fruit, avocado, pineapple and banana). Research on favorable areas for the development of palm and date trees is also planned;
- o Garden crops: Research relates to the selection and improvement of appropriate techniques, in particular irrigation (National Center in Bamako and support bases in the Koulikoro and Kayes circles);
- o Phytosanitary protection of fruit and garden crops: Studies and experiments are being conducted at the CNRF at Bamako to improve methods of protecting fruits and vegetables from diseases and parasites;
- o Fruit and garden produce technology: Additional equipment at the pilot plant and at the laboratory is being considered in order to analyze and study the methods of industrial processing of fruits and vegetables;
- o Research on tea and tobacco cultivation: With respect to tea, the current program in the Sikasso region is being conducted essentially in the fields of agronomy and harvest technology in order to arrive at maximum productivity. With respect to tobacco, research is being conducted in the High Valley Region. The research relates to agro-pedology, cultivation techniques, varietal selection, phytosanitary production and technology in order to determine the conditions necessary for high quality production; and

- o Regulation and control of selected seeds: Modern laboratories and offices were constructed at the Sotuba Station in 1980 to allow this section to carry out its mission. The National Operation for the Production of Seeds, recently set up in Segou, is responsible for disseminating the selected seeds.

In addition to the areas of direct involvement already described, joint research programs with international or regional organizations are being conducted in the projects associated with agronomic research. These projects are:

- o ICRISAT-Mali Associated Project (International Institute for Research on Cereals in Semi-Arid Tropical Zones). Varietal and technical improvement for rainfed cultivation of cereals (millet, sorghum);
- o SAFGRAD (OAU/CRST) Associated Project. Research and development on food crops in arid zones, Commission for Scientific and Technical Research, Organization of African Unity). Pre-extension work on improved varieties of cereals and pulses, as well as cultivation practices compatible with small farm agricultural systems;
- o WARDA Associated Project (West African Rice Development Association). The Special Research Project in Mopti has regional responsibilities and deals with the selection of improved varieties of floating rice and the improvement of cultivation techniques. A coordinated test program is also conducted within the Division of Agronomic Research and certain rice cultivation development operations;
- o OMVS Associated Project (Organization for the Development of the Senegal River, Same Agronomic Research Project). Varietal and agronomic tests on cereals (rainfed and irrigated) and on pulses; and
- o IER/IFDC Joint Project (International Fertilizer Development Center). To determine the agronomic efficiency of various sources of phosphate (natural phosphate from Tilensi, super phosphates and partially acidulous phosphates) likely to be used by the farmer.

In addition to these associated projects, efforts are being contributed by outside sources, integrated into the sections of the Division of Agronomic Research financed by the CILSS (improvement of millet, maize, sorghum, cowpeas, crop protection), the IDRC (food pulses project, cowpeas) and the World Bank (cotton experimentation, southern Mali).

- o At the level of the Rural Production Systems Research Division: This research program, directed by the DRSPR is designed to define a certain number of agricultural production systems apt to contribute to economic understanding of the rural world, and consequently, to improve the owner's situation (description, conception, experimentation and extension of the results). At present, this program is being conducted only in the southern portion of Mali, in the Sikasso region;
- o Bougouni-Sikasso Axis: Categorization of farms. Involvement in the farm environment followed by study and investigations into farm operations;
- o Fonsebougou area: Agricultural integration, livestock, protection of soil against erosion, categorization of farms and management counsel. Agronomic tests and studies; and
- o Tierouala Station: Test of cultivation system, cultivation associations and agronomic tests.

#### 5. Human resources and training policy

On December 31, 1982, the totals for trained personnel, active employees and employees in training at the IER were as follows: management staff, Category A, 135; Category B, 113; Category C, 109; and Category D, 1; making a total of 358 officials. Total conventional personnel was 357, making an overall total of 715.

Added to this, not including part-time assistance, are 22 expatriate management personnel working under the auspices of associated programs and five expatriates in the central units, working within a bilateral cooperation agreement with France.

Among the national officials, probably more than 90 percent are involved in research activities. The research personnel represent a wide range of educational backgrounds in Europe, America, Africa and Asia. Most of them, however, received their basic training from the IPR in Katibougou. The research staff still receives its specialized training overseas because Mali does not possess the necessary educational facilities.

Most of the research staff, which is relatively young, has attained the educational level of the baccalauréat plus four years of higher education. However, the number of doctorates in engineering, third cycle doctorates and M.S. degrees is continually increasing because of a dynamic educational program.

In relation to the available means and the current program, it seems that the number of research personnel is sufficient.

Furthermore, the Katibougou (Mali) Rural Polytechnic Institute and the Institute for Rural Economics are cooperating with the following institutions in the area of training.

In the field of agronomic and rural production systems research:

- o Gerdat Study and Research Group for the Development of Tropical Agriculture (GERDAT-Groupement d'étude et de recherche pour le développement de l'agriculture tropicale). Technical support and personnel loans for the conduct of research on cotton and jute fibers, food and oleaginous crops, and fruit crops;
- o Organization for the Development of the Senegal River (OMVS-Organisation pour la mise en valeur du fleuve Sénégal): Agronomic Research Project at Same (varietal and agronomic tests on cereals and pulses in the Kayes region);
- o Semi-Arid Food Grain Research and Development (SAFGRAD): Joint project 31, Technical and Scientific Commission of the OAU. Extension of improved varieties of cereal and pulses, as well as cultivation practices compatible with small farm agricultural systems;
- o International Crops Research Institute for the Semi-Arid Tropics (ICRISAT): Technical and varietal improvement for rainfed cultivation of cereal;
- o West African Rice Development Association (WARDA): Special research project at Mopti and coordinated tests on rice. Selection of improved varieties of floating rice and improvement of cultivation techniques;
- o Royal Institute for Tropical Regions (IRRT-Institut royale des régions tropicales): Support for research on production systems, Fongbou area. Case studies and tests in the Sikasso region;
- o CIBA-GEIGY S.A.: Participation in the creation of a research station in a semi-arid zone;
- o International Fertilizer Development Center (IFDC): Focusing and improving the formation of natural phosphates at Tilensí;
- o International Institute of Tropical Agriculture PMB 5320 (ITTA): Exchange of plant matter;
- o CIMMYT, Mexico: Exchange of plant matter;
- o Savannah Institute (IDESSA) Bouake, Ivory Coast: Exchange of plant matter;

- o Senegalese Institute for Agronomic Research (IRSA-Institut sénégalais de recherches agronomiques): Exchange of plant matter; and
- o IRCT, all stations outside of France: Exchange of plant matter.

#### 6. Financial resources

The summary of finances for all of IER in 1982 is given in Table 17.

This financing represents 2.1 percent of the agricultural Gross Domestic Product assumed by the five-year plan for the same year.

This, however, must not cover up the problems associated with the release of credits in the national budget which bear on all the major constraints to the effective conduct of research.

#### 7. Technical and scientific information resources

The various sources of scientific and technical information of the IER are as follows:

- o AGRIDOC-International Agricultural Documentation Counsel, 202, Rue de la Croix Nivert 75-38, Paris Cedex 15. Technical support, information exchange and index;
- o AGRIS-International System of Information for the Sciences and Agricultural Technology, Agris-Fao, Via Delle Terme di Caracalla, 00100 Rome. Information exchange and index.
- o CARIS-International Current Agronomic Research Information System, Via della Terme di Caracalla, 00100 Rome. Information and catalogue exchange on programs, institutions and research personnel;
- o RESADOC-Sahel Documentary Network, BP 1530, Bamako, Mali. Information exchange;
- o Senegal River Basin Commission Documentation Center, (OMVS-Organisation pour la mise en valeur du fleuve Sénégal), BP 383, Rue Duret, Saint Louis. Information exchange;
- o WARDA-West African Rice Development Association Documentation Center, Box 325, Monrovia. Information exchange;
- o ILCA-International Livestock Center for Africa Documentation Center, Box 5689, Addis Ababa. Information exchange;
- o Niger River Commission Documentation Center (CFN-Commission du fleuve Niger), BP 933, Niamey. Information exchange;

Table 17: Financing of the IER  
(millions Mali francs)

<u>Budget</u>	<u>Income</u>	<u>Expenditures</u>
National Budget	983,375,000	1,000,690,934
Foreign Financing	<u>1,259,406,745</u>	<u>1,259,406,745</u>
TOTAL	<u>2,242,781,745</u>	<u>2,260,097,679</u>



- o OECD-Documentation Center, 94, Rue Chardon Lagache, 75016 Paris. Information exchange;
  - o IDRC-International Development Research Center, BP 8500, Ottawa. Information exchange;
  - o Michigan State University Documentation Center on the Sahel, East Lansing, Michigan 48824 (USA). Information exchange;
  - o IITA-International Institute of Tropical Agriculture, PNB 5320, Ibadan. Information exchange;
  - o Institute for Agronomic and Rural Training in Hot Climates (IFARC-Institut pour la formation agronomique et rurale en régions chaudes). Association of research organizations and university organizations. Organization and conduct of an annual training program under the auspices of research grants (extended training third cycle internship);
  - o Mediterranean Agronomic Institute (IAM-Institut agronomique méditerranéen). Participation in training under the auspices of programs defined by IFARC;
  - o Pan African Development, West Africa, Sahel (IPD-AOS-Institut panafricain de développement-Afrique de l'ouest-Sahel). Organization of training seminars;
  - o Agency for Technical and Cultural Cooperation (AGECOOP-Agence de coopération culturelle et technique). Organization of economic training seminars;
  - o FAO Research Service on Development Training and Policies-Policy Analysis Division. Organization of seminars on economic training;
  - o Ford Foundation. Personnel loans for the training of agro-economists within research organizations. Organization, financing and conduct of training at the University of Ibadan (Nigeria); and
  - o Sahel Institute. Fellowship awards for research training.
- B. National Institute for Animal Husbandry, Forestry and Hydrobiological Research (INRZFH-Institut nationale de la recherche zootechnique, forestière et hydrobiologique).
1. Sponsoring ministry

The sponsoring ministry is the Ministry of Rural Development.

## 2. Mission and objectives

The National Institute for Animal Husbandry, Forestry and Hydrobiological Research is responsible for successfully conducting all fundamental and applied research relating to animal husbandry, forestry and hydrobiology within the guidelines of the national economic and social development plan.

In this endeavor, and in cooperation with the other departments and services, the National Institute for Animal Husbandry, Forestry and Hydrobiological Research has the following tasks:

- o The design, management and implementation of animal husbandry, forestry and hydrobiological research programs;
- o The supervision and coordination of the organizations and authorities which may be called upon to conduct, in or for Mali, research on animal husbandry, forestry and hydrobiology; and
- o The build-up, conservation, and productive use of national scientific assets within its area of specialization.

### a. Structure and organization of the INRZFH

Under the authority of a director assisted by an assistant director, the INRZFH carries out its activities through three main divisions:(See Figure 14)

- o The Administrative and Financial Division (DAF-Division administrative et financière), which deals with general administrative problems, personnel management, and accounting;
- o The Animal Husbandry Research Division (DRZ-Division de recherche zootechnique), whose mission is to conduct research on animal production as well as to coordinate the activities of the international and regional animal husbandry research organizations;
- o The Forestry and Hydrobiology Research Division (DRFH-Division de recherche forestière et hydrobiologique), whose mission is the planning and technical control of various forestry and hydrobiology research and experimentation programs conducted in the centers and stations in the fields of forestry, forest development, hydrobiology, fish breeding, ecology and cybernetics. It is also responsible for the control and coordination of the activities of associated forestry and hydrobiology research projects in the Republic of Mali; and
- o INRZFH centers and stations. Animal husbandry research is conducted within four research structures situated across the country, namely, the Sotuba Animal Husbandry Research Center, the Sahel Livestock and Animal Husbandry Research

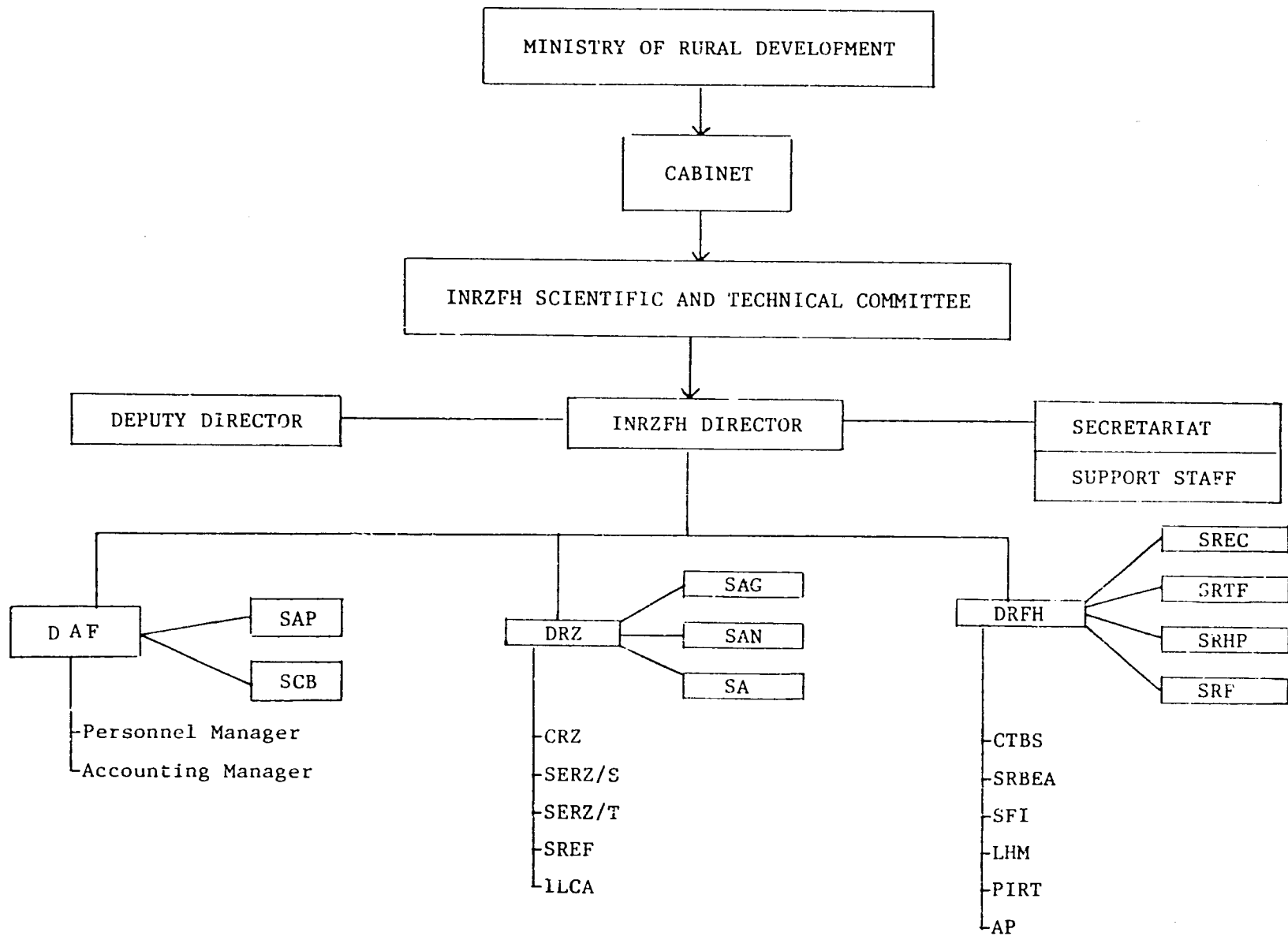


Figure 14: Organizational Chart of the INRZFH

Station, the North Mopti Research and Forage Test Station, and the Toronké Livestock and Animal Husbandry Research Station at Kayes. These centers and stations are attached to a central structure which is the Animal Husbandry Research Division of the INRZFH, which is in turn divided into three sections: the Genetic Improvement Section, the Food and Nutrition Section, and the Agriculture and Livestock Section. The internal structures of these stations and centers depend on the specific tasks which have been assigned to them.

b. The Sotuba Animal Husbandry Research Center (CRZ-Center de recherches zootechniques de Sotuba)

In 1961 the Federal Animal Husbandry Research Center was transferred to Mali and became the National Center for Animal Husbandry Research (CNRZ-Centre national de recherche zootechnique). The CNRZ currently possesses 1,000 ha, of which 300 ha have been cleared of brush and 157 ha are arable. Crops are grown each year on 30 ha used as experimental plots (forage crops, 5 percent; seed production, 10 percent; the remainder, other uses including cereal and fodder), and 205 ha are used as natural pasture. A significant portion of the land has been subject to unrestrained occupation by the neighboring population and other areas have been allocated to outside services (agronomic research, a poultry farming center, nursing and veterinarian schools, etc.).

The infrastructure includes:

- o Four laboratories (bromatology, 450 m<sup>2</sup>; mycotoxin, 120 m<sup>2</sup>; digestibility, 50 m<sup>2</sup>; agrostology, 50 m<sup>2</sup>) in fairly good condition with satisfactory equipment;
- o One greenhouse (40 m<sup>2</sup>) in fairly good condition with average equipment;
- o Six offices in fairly good condition and fairly well equipped; and
- o Three workshops (mechanical, ironworks, carpentry) in fairly good condition and with average equipment.

Other research buildings include one pig sty, four stables, six hen houses, one incubator, one pharmacy, one livestock feed manufacturing shop, and one chicken coop. With the exception of one stable, all of these buildings are old and require extensive repair. The equipment is dilapidated and often unusable.

c. Sahel Livestock and Animal Husbandry Research Station  
(SERZ/S Niono-Station d'élevage et de recherche  
zootechnique du Sahel-Niono)

Established in 1963, this station received some infrastructure from the Niger Office. Its area consists of nearly 12,000 ha of land. The number of ha under cultivation comes to 250 ha, of which 15 percent is reserved for experimental plots, 2 percent for seed multiplication and 83 percent for other uses (forage production). 200 ha are irrigated, of which 15 percent is used for experimental plots, 5 percent for seed multiplication, and 80 percent for other uses. Nearly 11,500 ha are reserved for natural pasture.

The station possesses two laboratories, one for parasitology with 40 m<sup>2</sup>, in fairly good condition but badly equipped, the other reserved for bromatology with 40 m<sup>2</sup>, also in fairly good condition but badly equipped. It also possesses 10 offices, of which only six are in good condition, and four stables, in good condition. Scientific equipment is practically non-existent.

To sum up, the infrastructure is weak. It should be noted that the irrigation network is in poor condition and requires substantial reworking. The equipment is also scarce.

d. Toronké Livestock and Animal Husbandry Research  
Station (SERZ/T Kayes-Station d'élevage et de recherche  
zootechnique du Toronké)

Although created and organized by ministerial order in 1977, this station does not possess any infrastructure as its progress was halted by a cutoff in funding. It is currently housed in the offices of the Regional Veterinary Administration of Kayes and conducts on-site studies. A 700 ha ranch is being developed.

e. North Mopti Forage Research and Testing Station

This station, also created by ministerial order in 1982, operates an infrastructure inherited from the Livestock Development Operation in Mopti (ODEM-Opération de développement de l'élevage à Mopti). Unfortunately, the program which it has been assigned has not yet begun due to lack of resources.

The existing infrastructure, all of which is in good condition, comprises five offices, one laboratory, one hangar used as a maintenance shop, and one warehouse.

The property covers 150 ha, of which 12 ha can be irrigated.

Research in the stations is conducted in four directions:

- o Research into high yield genetic material adapted to the local environment;
- o Research into diets appropriate for modern livestock based on the agricultural production of the area; and
- o The creation of artificial pastures and the improvement of natural pastures; the extension of rational livestock methods through the development of economically feasible herding methods.

In order to best accomplish these tasks, the stations are organized into sections:

- o The genetics and livestock section is responsible for the genetic improvement of livestock through selection and cross-breeding methods;
- o The nutritional-biochemical section is responsible for nutritional studies and analyses of livestock feed; and
- o The agrostology section deals with forage crops and pasture improvement.

f. Animal Husbandry Research Division

The Animal Husbandry Research Division has one research program associated with the ILCA (International Livestock Center for Africa) for the arid and semi-arid zones found in the Niono region. This program consists of research into constraints on livestock production systems and the introduction and testing of forage species.

A second ILCA associated program for the sub-humid zone is just getting underway with financial assistance from USAID.

g. Forestry and Hydrobiology Research Division

The Forestry and Hydrobiology Research Division is currently organized into four research sections:

- o The section for Research on the Ecology and Conservation of Natural Resources;
- o The section for Research on Forest Technology;
- o The section for Research on Hydrobiology, Fishery and Fish Breeding; and
- o The section for Research on Fauna.

The activities of the DRFH are conducted in the research stations and centers which are structures attached to the Division.

(1) The Center for Savannah Wood Technology  
(CTBS-Centre de technologie des bois de savane) in  
Katibougou.

It is located at the Rural Polytechnical Institute (IPR-Institut polytechnique rural) in Katibougou and consists of an experimental sawmill whose purpose is to specify the best conditions for working with the principal species of savannah wood, considering the inventory and utilization of local wood.

The CTBS hopes to attain the following objectives:

- o Determine principal and secondary uses of commercial wood; and
- o Develop processing techniques (log cutting, drying, machine finishing) for local wood.

(2) Research Station on the Biology of Autochthonous  
Species (SRBEA-Station de recherches sur la  
biologie des essences autochtones)

The Center is located in Katibougou and consists of an experimental nursery and a transplant plot used for research on native species to be used for forestation.

To attain this goal, the Station conducts:

- o Germination tests to learn the variation in the rate of germination in relation to the length of time the seeds have been stored;
- o Cutting tests to learn which species best lend themselves to this method of production; and
- o Transplant tests to learn the behavior of species used for reforestation.

(3) Station for Research on Irrigated Forest  
Plantations (SFI-Station de recherches sur les  
plantations forestières irriguées) in N'Debougou,  
Niger Office

Created in 1976, this station is located in the fields of N'Debougou on an area of 66 ha of land abandoned by the Niger Office. The station operates a nursery with equipment and a number of plantations, used to ascertain, through the creation of irrigated plantations, the conditions necessary to satisfy wood demand of the rural Sahelo-Sudanien populations.

(4) The Mopti Hydrobiological Station (LHM-Laboratoire d'hydrobiologie de Mopti)

This station was attached to the Forestry Research and Hydrobiology Division in 1976. The current mission of LHM is to conduct research designed to improve fish yields while protecting the ichthyological stock from depletion (knowledge of stocks, fish survey, species biology, statistics and unloading).

(5) Land Resources Inventory Project (PIRT-Projet inventaire des ressources terrestres) in Sotuba

This is an associated research project on soil, vegetation and water, financed by USAID with staff provided by the FAC (Fonds d'aide et de coopération) with the aim of conducting a cartography of the soil, vegetation, and water (both surface and ground water) of Mali.

The project is being conducted under contract by an American firm in collaboration with a Malian staff composed of various technicians in five divisions: the Pedology Division, the Ecology Division, the Water Division, the Planning Division, and the Documentation Division.

(6) Paper workshop

The paper workshop is responsible for experimentation on agricultural and forestry by-products for local, small-scale manufacturing of paper, research into possibilities for use of such paper, and research into possibilities for paper production on a village scale.

The CRZ of Sotuba, one of the oldest research organizations in the country, operates a number of facilities and equipment which are relatively apt, but "the facilities are in general old and in need of substantial repair." For the Niono Station "the infrastructure for livestock has remained the same. The irrigation network is in poor condition and requires significant repair. The land inherited from the Niger Office has been abandoned for a long time and needs to be redeveloped."

h. Programs and projects

At the level of the Animal Husbandry Division the principal lines of current research are as follows:

- o Contribution of a natural pasture for livestock in the Sudanian zone;
- o Contribution of phosphorous for the study of Mucuna Atterima, a tropical forage plant;
- o Development of improved forage crops in the Sudan-Sahel zone (Upper Volta, Mali, Niger);



- o Research on other unconventional energy feed crops for rational nutrition of domestic animals;
- o Continued upkeep of the Niono Ranch;
- o Genetic improvement of cattle (Sotuba Station program);
- o Cattle breeding for the production of milk and meat in Niono;
- o Revealing the milk potential of Zebus Maures and Peuls (Niono);
- o Determination of cattle age by dentition analysis (Niono);
- o Regulation of milk and butter production (Niono);
- o Study of the nutritional value of the pasture land of the Niono Sahel Station;
- o Study of the correlation between the quantity ingested by cattle and the quality of the pastures within a semi-intensive livestock system;
- o Study of bovine genetic resources in the North Kayes pasture region;
- o Evaluation of the pasture potential of the SERZ/T Kayes ranch;
- o Genetic improvement of hogs through cross-breeding (CRZ Sotuba);
- o Artificial insemination on cattle herded by ranchers on the outskirts of Bamako;
- o Genetic improvement of the local poultry stock (CRZ Sotuba);
- o Studies of the sexual cycle of the females of local races (N'Dama and Zebu Maure); and
- o Timing for the cutting of fodder millet, cutting periodicity: 3, 4, 5, 6, 7 weeks (Niono).

The Animal Husbandry Research Division has one research program associated with the ILCA for the arid and semi-arid zones found in the Niono region. This program is an effort to identify the constraints on livestock production and to introduce and test forage species.

A second ILCA associated program for the sub-humid zone is getting underway with financial support from USAID.

At the level of the Forestry and Hydrobiological Research Division the programs are:

- o Savannah wood studies which include a study of cross-sections and sorting of the savannah species; a study of the material yield in relation to the method of lumber conversion of lingue, karite, dougoura and sanan; a study of the preservation of kapok billets (various preservative products); a study of the drying and sorting of lingue, karité, dougoura and sanan lumber; and tests of natural and acquired durability and new tests;
- o Research on the biology of native species, such as the study of transplant plots; germination tests, both in the ground and in bags; transplant tests on plants with exposed roots and in pots; and direct seed planting tests;
- o Research on irrigated forest plantations, including the selection of species and origins most appropriate for the environment and the study of their behavior; perfection of simple planting techniques which require little or no additional water; and extension of acquired knowledge to farmers in the region;
- o Fisheries research includes a fishing study; an experimental fishing with seines and nets; and a study of fish consumption in the town of Mopti, the surrounding region and the camps along the river;
- o The Associated PIRT Program has the objectives of collection and processing of all existing data on natural resources; production of Landsat images in color; inventory of land and water resources; evaluation of the potential of the resources; and printing of maps and reports;
- o On-the-job training of Malian technicians includes the purchase of project equipment; and
- o Small-scale paper manufacturing includes experimentation on agricultural and forestry by-products; possibilities for use of the obtained paper; and possibilities for production on a village scale.

1. Human resources and training policy

Research personnel (Category A) number 72, including six veterinarians, 14 agronomic engineers, 14 animal husbandry specialists, 17 water and forestry engineers, 19 independent biology professors, and two chemists. Management personnel in Category B number 48 and junior technicians 35. This comes to 155 professional staff and 178 general administrative staff, or a total staff of 333.

The research personnel represent a wide variety of training backgrounds and experience. Most of the agronomists and water and forestry engineers were educated at the Katibougou Polytechnic Institute and have obtained a M.S. degree (baccalauréat plus four years). The professors, for the most part have doctorate degrees. As in the case of the IER, a training and specialization program is underway and the number of doctorate and M.Sc. degree holders is increasing satisfactorily (thus, in the DRFH, eight researchers are being trained in France and the United States, and each should return with a doctorate or a M.Sc. degree). It has also been noted that the number of managers in Category B, assistant research level, is only half the number of full-fledged researchers, the inverse of what would normally be true.

j. Financial resources

The 1983 INRZFH budget was FM 410,053,000, representing about 32 percent of the total credits requested. INRZFH is, therefore, receiving barely one-third of the credits requested for the implementations of its programs, that is, credits received out of the Mali national budget.

For associated projects, 1983 budget figures are not available, but projecting from previous years, it can be estimated that expenditures for the ILCA and PIRT programs and technical irrigated plantation projects will be FM 830 million.

The total credits allocated to animal husbandry, forestry, and hydrobiological research would then come to about FM 1,200 billion, or almost half the resources allocated to IER for agronomic research within that institute.

Financing from external sources is estimated to be twice as high as financing from the national budget, but this could be an over estimation due to lack of available data.

k. Technical and scientific information resources

The various scientific and technical information sources of the INRZFH are as follows:

Institute of Livestock and Tropical Veterinary Medicine in Tropical Countries (IEMVT-Institut d'élevage et de médecine vétérinaire tropicale), information exchange; Technical Center for Tropical Forestry (CTFT-Centre technique forestier tropical), information exchange; ILCA, information exchange; IDRC, information exchange; RESADOC Sahel Institute, information exchange; FAO seminar organization; French Cooperation Mission, research training; Sahel Institute, research training; and Office of Overseas Scientific and Technical Research (ORSTOM-Office de la recherche scientifique et technique d'outre-mer), information exchange.

C. The Central Veterinarian Laboratory (LCV-Laboratoire central vétérinaire)

1. Sponsoring ministry

The LCV is placed directly under the jurisdiction of the office of the Ministry for Rural Development.

2. Mission and objectives

The LCV is an industrial and commercial type public service endowed with financial and managerial autonomy. Its mission includes:

- o Assure the protection of animals against infectious diseases through the production and sale of vaccines;
- o Contribute to the prevention and eradication of animal diseases through laboratory diagnosis and medical research;
- o Assure, in the area of public health, the detection of animal diseases which are transmittable to man, as well as the microbiological analysis of food, water and beverages; and
- o Participate in technical training and retraining of management personnel in the field of laboratory techniques.

3. Structure

The LCV does not have centers or stations associated to it. It is structured as follows: a director general, a deputy director general, an administrative and financial division, a vaccine production division, a diagnostic and research division, and a technical and general maintenance division. (See Figure 15.)

The two principal structures, therefore, are: the Vaccine Production Service, and the Diagnostic and Research Service. These structures have three well-equipped laboratories with top-quality and sophisticated material. Logistical means are sufficient. The documentation service is substantial. The LCV also has two refrigerated chambers (for freezing and refrigeration) in excellent condition. It also has two administrative offices in good condition, a maintenance workshop in good condition and well-equipped with a cattle shed, and a stable, also in good condition.

4. List of programs and projects

The list of programs and projects is as follows:

- o Program No. 1: Bacteriology, USAID sectorial project;
- o Program No. 2: Virology, USAID sectorial project;
- o Program No. 3: Protozoology, USAID project;

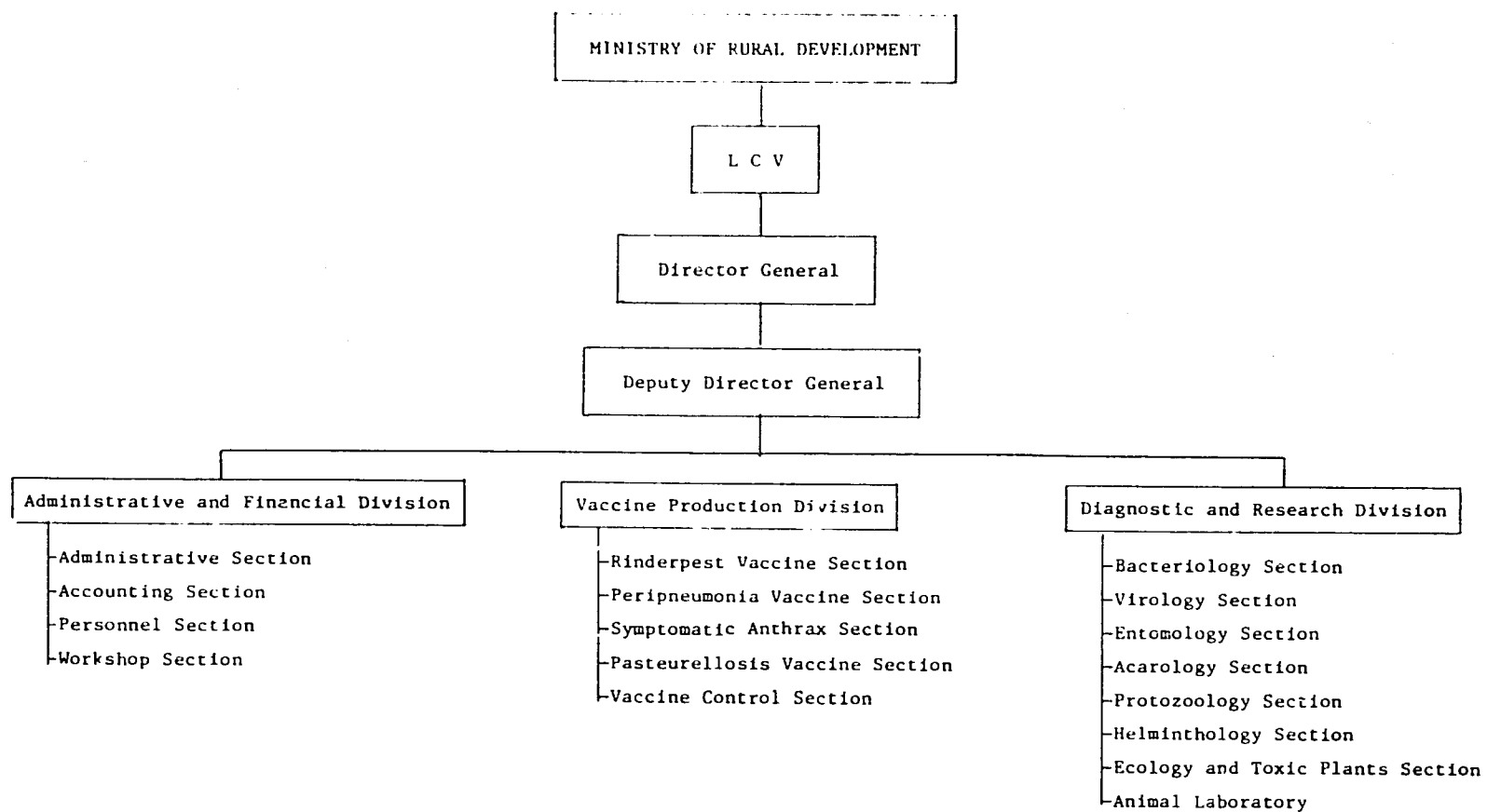


Figure 15: Organizational Chart of the Central Veterinary Laboratory

- o Program No. 4: Entomology, USAID project;
- o Program No. 5: Acarology, USAID project;
- o Program No. 6: Helminthology, USAID project;
- o Program No. 7: Ecology and toxic plants, USAID project;
- o Program No. 8: Rinderpest vaccine production section;
- o Program No. 9: Contagious bovine peripneumonia vaccine section;
- o Program No. 10: Symptomatic anthrax section;
- o Program No. 11: Pasteurellosis and anthrax section;
- o Program No. 12: Vaccine control section; and
- o Program No. 13: Workshop.

#### 5. Human resources and training policy

The research personnel is highly specialized, with five to seven years of training after the baccalauréat. It is essentially composed of veterinarians, but the number (nine) remains insufficient. The technical staff, also insufficient in number, is composed of a substantial number of animal husbandry engineers, with the remainder consisting of laboratory technicians. This staff is also well trained and numbers 42, of which 14 are engineers.

Recruitment needs for the next three years call for five veterinarians and 10 engineers. The vaccine production facilities have always been operated exclusively by Malian personnel.

The LCV is provided with a continuing training program, particularly for specialists, in the developed countries. Six managers are expected to receive highly specialized training in the next three years.

#### 6. Financial resources

Operating funds are sufficient; the LCV enjoys substantial financial support from USAID, which has been constant since 1965. Amounts received from USAID for the period 1965-1982 are: US\$ 1,955 billion (Loan 625-H003), US\$ 1,737 billion (Subsidy 625-0610), and US\$ 1,074 billion (Subsidy 688-0203). The average aid for the last three years has been FM 293 million. For the national annual budget, the average is FM 285 million. The LCV is currently independent as regards financial management and has the right to sell the vaccines.

## 7. Scientific and technical information resources

The documentation service is substantial. The total number of books is estimated at 200 and the number of new acquisitions each year is 50. Access to external information sources is relatively easy.

### D. The ILCA-Mali Associated Program for Arid and Semi-arid Zones (ZASA-Programme des zones arides et semi-arides)

#### 1. Sponsoring ministry

The Mali correspondent for the ZASA program is the Ministry for Rural Development, following the signature on January 31, 1976 of the general cooperation agreement between Mali and ILCA.

#### 2. Mission and objectives

Created in 1974, the ILCA (International Livestock Center for Africa) is an international agricultural center whose work is exclusively devoted to production systems in which animal production plays an important role. Its headquarters are in Addis Ababa, Ethiopia. Its research activities and facilities are decentralized into national programs outside of headquarters which are representative of the different ecological zones in tropical Africa. The mandate of the ILCA covers not only research, but also documentation, information and training.

The ILCA/Mali program is a principal component of the ILCA general research program on animal production systems in the arid and semi-arid zones of Africa. The objectives of this program are:

- o To furnish information on the statistical structures and dynamics of the animal production system in a manner which can serve as a basis for improvements (biotechnical and institutional) allowing the identified trends to be reversed;
- o To develop improvements and evaluate their effects, not only on the performance of individual units, but also in relation to their application in a regional and national context;
- o To develop data collection techniques appropriate for the permanent evaluation of the extensive animal production system; and
- o To furnish comparative data on extensive systems of animal production in order to extrapolate this knowledge into other similar systems in the arid and semi-arid zones.

In the ILCA/Mali associated program, emphasis has been particularly placed on the interactions between zones and their influence on animal production, such as: dry areas and areas subject to floods, pastoral zones and rainfed agriculture, and pastoral zones and irrigated agriculture.

### 3. Structure

The program is structured into various research centers and stations. The Malian government has agreed to provide the ILCA with infrastructure and personnel of the Sahel Livestock and Animal Husbandry Research Station (SERZ/S) at Niono.

In addition to this structure, the ILCA also uses the bromatological analysis laboratory of the Sotuba Center for Animal Husbandry Research (CRZ-Centre de recherche zootechnique) as well as the Central Veterinary Laboratory (LCV).

In addition to the facilities made available by Mali, the ILCA has its own infrastructures in Bamako and Niono. In Bamako, this includes four administrative offices, three research offices, two offices for documentation, one workshop for the garage, and one warehouse all in good condition. In Niono, this includes one office for documentation in fairly in good condition, five research offices in fairly good condition, and one seed warehouse in good condition.

The headquarters of the ILCA program are based in Bamako, with a research base in Niono, under the direction of a program director. ILCA/Mali is thus composed essentially of two research teams. An Administration and General Services Section provides the logistical support necessary to the research activities.

### 4. List of programs and projects

ZASA is comprised of several programs as follows:

- o Program No. 1: Study of the production and development possibilities of ligneous forage plants;
- o Program No. 2: Experimental analysis of the possibilities for improving the production and use of natural pastures through the Niger flood plains;
- o Program No. 3: Research on the constraints to growth and production of millet and cowpeas in mono- and mixed crops;
- o Program No. 4: Research on varieties of forage and mixed pulses (principally cowpeas) and research on mixed crops of millet and cowpeas and research on side effects;



- o Program No. 5: Selected cowpea crops in the traditional village environment;
- o Program No. 6: Village socio-economic tests. Field study of the harvest, anthropometry, and consumption. Measurement of the output of ploughing oxen; and
- o Program No. 7: Program on the feasibility of pasture units, determination and identification of pastoral territories, and cartography of transhumance paths.

#### 5. Human resources and training policy

A profile of ILCA staff for 1982 is shown in Table 18.

Since it is also a training organization, the ILCA has established a dynamic short-term, on-the-job training policy through the organization of seminars, courses, etc., and the award of study grants. The Mali research services also benefit from this training policy.

#### 6. Financial resources

An autonomous, apolitical, non-profit organization, the ILCA is financed by the International Consultative Group for Agricultural Research (GCRAI-Groupe consultatif pour la recherche agricole internationale), which was established in 1971 to contribute to improving research productivity, and in so doing, to accelerate the agricultural development in the regions of the Third World (Africa, Asia, South America).

The average level of financing of the ILCA/Mali program for the last three years amounts to US\$ 100,000 for investment and US\$ 900,000 for operations. The financial support is constant.

#### 7. Scientific and technical information resources

With a mandate for documentation and information, the ILCA/Mali has a substantial library on its premises with 32,314 books, and 350 new acquisitions each year (350 titles). The number of scientific reviews and journals is 23.

ILCA/Mali enjoys strong support from the documentation service at the Addis Ababa headquarters. The information sources of ILCA/Mali are varied (the Sahel Institute, Institute for Rural Economics, Mali Office for Livestock and Meat, U.S. Agency for International Development, etc.).

Table 18: ILCA Personnel, 1982

<u>Categories</u>	<u>Number at Year End</u>
1) <u>Expatriates</u>	
Professional Managers	5
Consultants	1
Volunteers	4
FAO Associated Experts	1
2) <u>Nationals</u>	
Professional Managers	4
Support Personnel	93
Temporary Personnel	<u>13</u>
TOTAL	<u>127</u>

E. N'Dama Yanfolila Operation (ONDY-Operation N'Dama Yanfolila)

1. Sponsoring ministry

ONDY is under the jurisdiction of the Ministry for Rural Development.

2. Mission and objectives

Created in 1975, ONDY is a public organization and a separate legal entity with financial autonomy. Its headquarters are in Madina Diassa (Yanfolila Circle).

Its mission is to improve the N'Dama cattle stock through the selection method and to supply quality breeding animals, both to farmers who request them and to animal breeders in the Yanfolila Circle, with the best sanitary guarantee.

3. Structure

ONDY possesses an animal husbandry station that conducts tests on the selection of breeding females by evaluation of bio-economic factors (precocity, fertility, format, confirmation) and the selection of male studs through the descent test. ONDY is headed by a director assisted by an assistant director. It is structured in three sections: the Agro-pastoral and Rural Engineering Section, the Management and Administration Section, and the Veterinary and Animal Husbandry Section. It also includes a medical base and a school.

The station (there is only one) includes three offices for administration and management in fairly good condition, two offices for the technical sections, also in fairly good condition, four workshops (mechanical, ironworks, carpentry, electrical) fairly well equipped and in fairly good condition, one health and animal husbandry station in fairly good condition, and 20 night stations to shelter ailing livestock.

The livestock and agricultural equipment is sufficient and in good condition. It comprises a laboratory without sophisticated equipment, a library, rather poorly furnished, and a ranch with a surface area of 17,000 ha divided into seven developed blocks possessing 20 night stations. The area under cultivation amounts to 12 ha; 12,00 ha are used as pasture.

4. List of programs and projects

The various programs include:

- o Program No. 1: Cattle selection in the N'Dama station;
- o Program No. 2: Glossina control; and
- o Program No. 3: Pasture improvements.

## 5. Human resources and training policy

ONDY is staffed by expatriate agents and permanent nationals. For the nationals, there are two research staffs each composed of two research managers, including the director (veterinarian), two animal husbandry technicians, five administrative personnel, and five support agents. For the expatriates, there are two expatriate managers (including one veterinary zootechnician and one agro-pastoralist). The operation also receives substantial consulting support from external organizations (e.g., the IEMVT). The training program is somewhat tentative as there appears to be no clear, consistently punctual and coordinated training policy.

## 6. Financial resources

The operation enjoys financial management autonomy and benefits from substantial financial support from the European Development Fund (EDF). The average level of foreign financing (EDF) for the last three years amounted to FM 96,651,699. Support from the national budget is also constant; the average for the last three years was FM 10,768 million.

## 7. Scientific and technical information resources

The operation has a 100-volume library. It remains scientifically isolated because of the physical location of the headquarters. It must, nonetheless, be noted that rather developed scientific collaboration exists between the operation and several foreign and national research institutions.

## F. Critical Sectoral Analysis

### 1. Sectoral summary

#### a. Agronomic research

Until 1960, most of the agricultural research was conducted directly by or, at the very least, under the direction and scientific and technical control of the Bambey (Senegal) Federal Center for Agronomic Research and the Niger Office.

In 1961, a Mali Agronomic Research Service was essentially created with the role of coordinating the various research organizations working in Mali. That same year, the Division of Agronomic Research was given direct responsibility for certain components of the research programs.

It was not until 1962 that IRAT, IRCT and, beginning in 1963, IFAC, progressively took over the research activities within their areas of specialization, through agronomic research technical assistance agreements concluded with Mali. These French institutes conducted specialized research until 1973 for IFAC, and in 1977 for the two others, when the government decided to delegate financial and technical management to the national structures of the Division of

Agronomic Research. Today, an essential role has been assigned to agronomic research in meeting the development objectives of the five-year socioeconomic development plan 1981-85 and the food strategy recently adopted by the government, whose principal objectives are to meet the population's demand for various agricultural products, principally food (cereal, fruit, vegetables) and to meet the demand for raw materials of existing or prospective industries (cotton).

In other words, to attain the following objectives in the agricultural sector, it will be necessary to achieve food self-sufficiency for the various population, regardless of climatic conditions, and to assure the control of water, necessary not only to achieve food self-sufficiency, but also to halt the exodus from rural areas.

Crop production must reach the estimated levels shown in Table 19 by 1985.

b. Animal husbandry

Action in the area of animal husbandry research includes research into highly productive animals through genetic improvement, research into better animal husbandry conditions which do not endanger the environment, and study of the conditions necessary for the dissemination of research results. These activities have been going on in the country for more than 80 years within several successive structures.

In 1906, before 1960 Independence, a sheep station was built near Niafunke in order to improve the quality of so-called Macina sheep's wool by crossing it with improved European stock. The results were encouraging: 330 metric tons of poor quality wool in 1914 compared with 300 metric tons, of good quality wool in 1927. This led to the creation of other sheep stations such as those at El Houaladji, Gao, Mopti, Nara, and Nioro. This last station was to deal with the production of sheep for wool.

In 1927, tentative tests to improve the bovine stock through cross-breeding to improve milk production was initiated at the Sotuba farm. These tests were to be taken up again with greater commitment by the Niger Office. The results at Sotuba, like those at the Niger Office, were very encouraging because animals were obtained which were half Mont Beliards and Charollais producing up to nine liters of milk per day, compared with two liters per day from the local stock.

In 1950, the Sotuba farm became the Federal Center for Animal Husbandry Research and changed the method of genetic improvement, adopting the method of selection. It was no longer controlled by the territory in which it was located and its research took on a fundamental character.

Table 19: Estimates of Crop Productions, 1985  
(metric tons)

<u>Type</u>	<u>Quantity</u>
Grain Crops (millet, sorghum, maize, wheat, rice, fonio)	1,697,690
Cow peas, Vauzou	18,900
Vegetables	59,150
Sugar Cane	240,000
Cotton-Seed	180,500
Groundnuts in shell	180,000
Tabacco	1,100
Kenaf	500
Tea	200

After the 1960 Independence, conscious of economic realities, Mali undertook to find solutions to problems affecting the production of milk and eggs, which our country, though internationally known as a livestock-producing country, was forced to import for domestic consumption. Thus, the Sotuba National Center for Animal Husbandry Research (CNRZ-Centre national de recherches zootechniques de Sotuba) was created to deal with the problem of milk production by cross-breeding local stock with European stock which had high milk yields and were compatible with the local environment.

The second objective of the center was the promotion of poultry breeding by imports of chickens from temperate countries and study of their adaptability to our local livestock conditions.

Several other activities led to the determination of appropriate animals in order to establish feeding methods for the different species and experiment on foreign forage plants.

Since 1966, research activities on animal husbandry have continuously developed and diversified. Thus, the Sahel Livestock and Animal husbandry Research Station in Niono, created in 1972, took on the aspect of a veritable research center.

Beginning in 1975, several joint livestock research programs were initiated, including the Sahel Primary Production Project and the ILCA/Mali/Sahel International Animal Husbandry Center Associated Program. Two new stations, the Toronké Livestock and Animal Husbandry Research Station and the North Mopti Forage Research and Testing Station, were created in 1977 and 1982, respectively, and are beginning operations. Currently, all these activities are centralized and coordinated at the level of the Animal Husbandry Research Division of the National Institute of Animal Husbandry, Forestry and Hydrobiology Research.

The objectives of animal husbandry research have remained the same. Activities focus on four main directions:

- o Genetic improvement of the various species of domestic animals through cross-breeding and selection;
- o Improvement of livestock feeding conditions. Improved knowledge of available livestock feed (grasses, agro-industrial by-products, etc.) and study of their nutritive value with the aim of perfecting nutritional formulas which can be widely disseminated;
- o Improvement of pastures through research. More precise knowledge of the floristic composition of pastures, their dynamics, animal behavior vis-a-vis these pastures. Techniques for their use and possibilities for introduction and selection of forage plants; and
- o Study of the conditions necessary for effective dissemination of research results.

All of this research until then focused on the varietal improvement of plants, the genetic improvement of animals, and the cultivation and livestock techniques applicable to these improvements.

Although some excellent results were obtained in these fields, their application had not yet permitted a fundamental modification of existing production systems and behavior. For this reason, since 1976, it has been deemed necessary to launch integrated, multidisciplinary research in order to better understand the existing systems and perfect appropriate technologies to promote real economic and social progress for the rural population.

The ILCA was also concerned with the problems of animal production in tropical Africa, in particular the interdisciplinary study of animal production systems. Thus, an ILCA/Mali associated cooperation program fit in perfectly with the strategy and program for livestock development in Mali. And so it was that the cooperation agreement between Mali and ILCA, signed January 31, 1978, marked the beginning of the ILCA/Mali associated program (Program for Arid and Semi-arid Zones).

#### c. Veterinary research

The Central Veterinary Laboratory, the only veterinary research structure, was created on September 30, 1939, as a small serotherapy research unit within the livestock service. It was later connected with the George Curasson Federal Laboratory in Dakar, which opened in 1952.

Upon the birth of the Federation of Mali, it was necessary to intensify the production of vaccines to combat the great epizooties which were decimating our herds (rinderpest, peripneumonia, anthrax). The initial involvement of USAID allowed the construction of a small unit for a rinderpest vaccine for Mali, Upper Volta and Guinea. Subsequent involvement allowed the installation of a laboratory for large-scale production of vaccines and veterinary research. In 1973, the production of vaccines was 10 million doses.

In the field of veterinary research and diagnosis, a USAID subsidy led to the development of a study of trypanosomes, ticks, glossina and the conditions of their habitat. After a tentative beginning in 1977, a research team from Texas A&M University, completed all the work undertaken in the June 1981 program: research and training on the tsetse fly and cattle trypanosomiasis. Over a four-year period, this work entailed the preparation of activity reports, maps, and slides of all studies made.

Diagnostic activities are varied and relate to a variety of medical, nutritional, virological, serological, and parasitological analyses.



d. Forestry research

Forestry and hydrobiological research has been underway since 1960, but it was not until 1975, with the nomination of a Division Chief, that a program addressing certain development concerns of the forestry sector was established. Beginning in 1981, with the creation of the National Institute for Animal Husbandry, Forestry and Hydrobiological Research, the Division became more operational, endowed with a long-term program addressing two national priorities, namely, the fight against desertification, and satisfaction of the population's needs for forestry products.

The Forestry and Hydrobiological Research Division comprises four sections which are responsible for planning, designing, and coordinating all research activities. These sections are the Ecology and Natural Resource Conservation Section, the Wood Technology Section, the Hydrobiology, Fishery and Ichthyology Section, and the Fauna Section.

The research programs are conducted in the project stations, namely:

- o Station for Research on the Biology of Native Species (SRBEA-Station de recherche sur la biologie des essences autochtones);
- o Station for Research on Irrigated Forest Plantations (SFI-Station de recherche sur les plantations forestières irriguées);
- o Center for Savannah Wood Technology (CTBS-Centre de technologie des bois de savane);
- o Mopti Hydrobiological Laboratory (LHM-Laboratoire d'hydrobiologie de Mopti);
- o Paper Workshop (AP-Atelier papier); and
- o Land Resources Inventories Project (PIRT-Projet inventaire des ressources terrestres).

The Division's mission is to conduct studies and experimentation in the areas of silviculture and development as well as in the areas of forestry, fishery, and hunting.

(1) Human resources

The Division has 25 agents in Category A, four agents in Category B, one agent in Category C, and 29 general staff. An additional 12 agents are in training in national schools and foreign universities.

## (2) Financial resources

There are three types of financial resources: the national budget, foreign financing, and the National Forest Fund. For a resumé of the national budgetary and foreign contributions, see Table 20.

Each year the National Water and Forestry Administration allocates a forestry and hydrobiological research subsidy. In 1983, the amount was FM 10 million.

### 2. Principal problems affecting institutional capabilities

#### a. Agronomic research

Most of the constraints to the implementation of research programs are essentially linked to several factors. One notes that financing from the national budget is inadequate. The release of notified funds is frequently delayed. Payment by postal check, cashier's money order, and receipts for operating credits and capital investment are inappropriate for the acquisition of certain equipment, spare parts and material not locally available. There exists a persistence of remaining credits, due to delays in the release of funds. Difficulties, outside of Bamako, in acquiring the fuel necessary for essential trips during the course of experimentation, hindering the proper operation of the research bases and stations.

The above financial constraints have the following consequences: poor implementation of the research programs, reduction in the volume of research programs, inadequacy and dilapidation of the reception and equipment infrastructures, and research personnel, although not too numerous, are under-employed due to the inadequacy of material resources.

A lack of motivation exists among the personnel because of such factors as no research bonus or compensation for moving expenses for most employees, the status of researchers, which provides little incentive, the lack of housing for cadres, and the physical isolation of some researchers (remoteness of certain stations). Under-utilization linked with the inadequacy of material and financial resources, added to the living and working conditions (offices, housing, logistical facilities, bonuses and compensation) are, to say the least, discouraging and demoralizing for research personnel and constitute a serious threat to the maintenance of a qualified research staff who daily are confronted with concerns of a material nature which do not facilitate scientific work.

Most of the researchers are young. It is indispensable to increase their degree of specialization in order to assure dynamic development in all programs.

Table 20: Resources of the Division of Forestry  
and Hydrobiological Research  
(Mali francs)

National Budget (operations):

<u>Section</u>	<u>Amount</u>
Division	2,795,000
CTBS	1,600,000
SRBEA	1,600,000
LHM	1,600,000
SFI	1,600,000

Foreign Financing (as of 10/30/83):

<u>Recipients</u>	<u>Source</u>	<u>Total Cost</u>	<u>Incurred Expenses</u>
CTBS	IDRC	60,141,000	59,401,467
SFI	IDRC	70,104,000	62,104,000
AP	SUCO	2,050,620	0
PIRT	USAID	US\$ 5,220,000	US\$ 70,000

b. Animal husbandry and veterinary research

Animal husbandry research is essentially handicapped by the following problems:

(1) Financing

The level of financing and, above all, the system of financing are absurd. In general, research programs are not financed, and funding comes exclusively from the state budget. Quite often, these funds are sufficient only to cover maintenance activities at the stations because of their stationary level over the past several years. In addition, delays in the transfer of financing, the division of payment, and even payment freezes for indeterminate periods at the treasury level are causes for the non-execution of research programs. As a general rule, the proper conduct of research programs requires that financial resources be available at a sufficient level and be dispensed at a rate compatible with the conduct of experimentation. An experiment on cattle feeding planned for three months will provide no useful result if, due to lack of food, the researcher must stop the experiment after one or two months. Insufficient funding results in the following:

- o Under-utilization of research staff who most often have been trained at great cost;
- o The reduction of research programs to levels which are sometimes detrimental to progress in animal husbandry;
- o A feeling of frustration among researchers, leading quickly to discouragement and abandonment of the career; and
- o Stagnation in animal production for lack of constant research support.

(2) Lack of materials and equipment

Since 1960, animal husbandry research has benefitted from almost no investment and equipment credits. Installations, where they exist, are old and require major repair. The infrastructure for animal husbandry and research has remained stationary. Little financing from foreign sources has been available to equip the stations. Newly created stations (Toronké and North Mopti) suffer from a total lack of equipment and infrastructure or from a partial lack of infrastructure with no equipment.

This situation leads to research results obtained under conditions which are so difficult that their validity is questionable.

### (3) Insufficiency of high-level, experienced research professionals

Almost all our researchers are nationals (90 percent), young, and, therefore, inexperienced. They lack scientific orientation and the environment is not favorable to their development (physical isolation of the stations, the material situation, etc.).

However, there is a continuous overseas training program for all of them, which remains the only hope. But this hope will be in vain if the material conditions (salary levels, bonuses, job status, etc.) are not improved. The fact is that after these researchers have been trained at great cost, they are attracted upon their return to better paying, less professionally restrictive sectors. The solution is obviously to alter the status of all research personnel to provide greater incentive.

Veterinary research is still linked to foreign financing and foreign technical assistance. The sector requires more intensive support on the national level and is in dire need of qualified and specialized personnel in sufficient number. This sector is in its earliest stages, but the institution (LCV) has enormous potential (infrastructure, equipment, documentation) to allow veritable, ongoing veterinary research.

In the area of forestry and hydrobiological research, the principal problems can be summarized as follows: sporadic financial support and cutoffs in financing during the course of certain programs, insufficiently trained researchers, and dilapidation of equipment and laboratory facilities.

### 3. Evaluation of the problems affecting research personnel

In addition to the above-mentioned problems associated with financing (insufficient material means and equipment), from the organizational point of view, the existence of two separate agricultural research institutes (IER and INRZFH), whatever the motivations might be, is considered as a division among researchers, compared with the unity which existed previously.

The high degree of specialization in the agronomic research stations often does not allow them to utilize their full potential nor, above all, to accomplish their mission of coordinating the entire range of programs affecting their ecological zone, and does not facilitate coordination in the multidisciplinary approach.

Several agronomic research stations are accessible only with great difficulty. In addition to the physical isolation of certain stations, there is also a scientific isolation associated most often with inadequate scientific documentation. Material difficulties for researchers working exclusively for programs financed by the national budget do not facilitate their scientific work (lack of motivation, researcher status, etc.).

To all of the above, it must be added that a lack of sufficient specialists and a relatively low degree of experience could explain the lack of dynamism in certain programs.

In the area of zootechnical research, senior technical personnel is sufficient in number but under-utilized, due to lack of sufficient resources (material, equipment, financing for research programs). This personnel is scientifically isolated, lacks documentation, and often is not experienced and specialized. Junior technical personnel is also sufficient in number, but lacks adequate orientation and motivation. Routine tasks are accomplished fairly efficiently. Maintenance personnel is sufficient in number; the level is average, but has relatively little effect on research results.

Financial support in the form of credit entries from the national budget is constant, but foreign financial support is practically non-existent. The facilities are often dilapidated, poorly equipped, and inadequately maintained or practically non-existent.

Operating credits allocated to pure veterinary research are insufficient, and remain dependent upon foreign financing. There is an urgent need for qualified specialized personnel; however, junior technical personnel accomplish their assigned tasks well. Research equipment is adequate and in good condition. Maintenance personnel lack the material resources for maintenance. Financial support is constant both from foreign sources and the national budget. The Central Veterinary Laboratory has the right to sell the vaccines it produces and to manage the resulting revenues.

In the area of forestry research, the major concern is the notorious insufficiency of financial resources available for research. There is also an urgent need for training in several disciplines in order to properly conduct the research programs.

#### 4. Analysis of specific problems

##### a. Crop production

Climatic difficulties do not favor desired yields of certain crops which are already considered difficult to improve in the stations. Despite numerous results obtained by agronomic research on fruit trees, there is no extension organization for their application by the local farmers. Credit entries are not adapted to new programs. Significant problems, such as water economy, are not being studied due to lack of funds. Weed problems are of critical importance in many rice paddies and require the establishment of a more ample weed study program.

##### b. Animal husbandry and veterinary research

Animal husbandry research has maintained the same focus since independence. However, the themes have been diversified with the country's need for economic and social development strategies.

The specific problem is that spectacular results are difficult to achieve in short periods of time. Animal husbandry research calls for applied research, but development problems have been aggravated by natural calamities to the point that research can no longer propose solutions in sufficient time. A gap has thus opened between animal husbandry research on the one hand and development planning on the other, in which those in development no longer seem to recognize or appreciate the efforts being made in research.

In addition, animal husbandry research has long remained sectoral and isolated in the stations. Despite a number of significant results (the high performance of cross-bred or selected animals, among others), it must nonetheless be noted that these achievements have unfortunately not had the desired impact on livestock breeding overall. This is the case for several reasons:

- o In most cases, the results have been obtained under controlled conditions. Because many of the parameters are controlled (animal stocks, nutrition, veterinary care), conditions differ greatly from those in the rural environment; and
- o The transfer of significant results to the rural environment could not be made, due in part to the lack of appropriate structure and in part to the fact that improvement of the environment did not follow the genetic improvements in the animals.

These reasons question the policy of animal husbandry station research. Years of work in the stations have enabled researchers to obtain a good knowledge of the animals and the environment and to master certain techniques.

It is now necessary to transfer a large part of the station program to the rural area, so that animal husbandry research adheres more closely to the needs of our regions, with the assumption that the necessary resources for such a task will be available. It is a matter of creating permanent experimentation bases and support bases for animal husbandry research in the traditional environment.

Finally, it is noteworthy that since independence, no research program on small ruminants has been initiated, due to lack of funds.

Veterinary research was practically non-existent from independence until 1977. Action in this area remains tentative. On the other hand, support activity (services, vaccine production) at the Central Veterinary Laboratory is widely recognized, both within the country and among the community of donors as having contributed substantially to improving the health of the nation's livestock. It continues to provide significant support to the expansion in animal health services beyond the production of vaccines to areas such as improved diagnosis and prevention of illnesses transmitted by vectors.

Two factors have contributed largely to this success. The first is the stable, constant financial support from USAID over a period of more than 17 years. The second is the nature of the programs at the LCV. Fundamentally, they include separate measurable activities involving rather exact science (research on animal health and vaccine production).

c. Forestry production

Forestry production is the subsector for which research themes are the most varied. The specific problems are the youth of the researchers who often lack basic know-how and the insufficient number of specialists, particularly in the areas of genetics and biology.

d. Fishery production

Ichthyological research definitely lacks sufficient technical personnel (a total of two). A single specialist directs the Mopti hydrobiological laboratory.

5. Outline of solutions and possibilities for action

a. Agronomic research

In the area of agronomic research, the primary objective must be to provide the farmers with crop varieties which will contribute to achieving national food self-sufficiency. Varietal improvement should focus on the study and inventory of local and introduced material, the creation of synthetic varieties and the recurrent selection of varieties already obtained, and the creation of short-stemmed species.

The principal criteria for selection should be productivity, hardiness of the strain, and resistance to drought (adaptation of the vegetative cycle) and disease, as well as resistance to heavy wind and rain.

These improvement programs should be supported by technological nutritional actions. It will be necessary to better understand the relationship between soil, water, and plants in order to better define the crop aptitudes in the environment under study. The increase in the price of fertilizer should provide incentives for research into conditions which will assure its most profitable and efficient use. Similarly, techniques for working the soil are extremely important as a factor in water conservation. Research in support of rural development operations should lead to a better understanding of technical production systems.

Invasion of the fields by weeds is one of the principal problems confronting farmers. The development of methods for combatting these weeds is therefore a high priority. The same is true for insects. Methods for controlling borers can be oriented toward research into more resistant varieties and the use of pesticides, to the extent that profitability allows.



Finally, it will be necessary to take development action in such a way that results achieved in research can be applied by the farmers. It goes without saying that none of these programs can be conducted without the development of research structures and the training of personnel

b. Animal husbandry and veterinary research

In the area of animal husbandry and veterinary research, there is a need for organization of the Rural Development Operations, for structures for pre-extension which test animal husbandry research results on a life-size scale and under natural conditions. This should include the pursuit of genetic improvement activities for cattle, hogs, and poultry, applying the necessary means and covering all local stocks; the establishment of intensive research programs on small ruminants; the intensification of research on feed, pastures, and forage plants; a search for global financing for animal husbandry research; upgrading the status of researchers (research bonuses, various forms of compensation, researcher status); reinforcement of scientific documentation by providing fully-equipped libraries to the isolated (remote) stations; reinforcement of programs to train researchers and provide technical and scientific orientation for national personnel; and greater collaboration with the international agricultural research community with respect to requests for technical assistance.

c. Veterinary research

In the area of veterinary research, organization structures should include the planning of short, medium, and long-term research programs on animal health; the establishment of a scientific and technical committee on veterinary research; intensive training of specialized personnel; organization within development operations of components for accompanying research, veterinary research and support in the diagnosis of diseased animals; and greater national support for research programs.

d. Forestry production

In this area, there is obviously a need for experienced research personnel and technical assistance to provide on-the-job training of researchers. In addition, specialization in genetics and biology, which are lacking, must be a priority in the fight against desertification through the biological study of native species to be selected and promoted.

e. Fishery production

In this subsector, it will be necessary to train additional specialists in ichthyology who will provide on-the-job training to the technical extension personnel who have been assigned to them.

## 6. Comments

It was suggested that the program be designed by discipline and not by crop. This will permit better monitoring and support of researchers during their careers, interaction between researchers with the same specialization, optimization of research in the different programs and above all scientific continuity and methodological homogeneity at the national level.

These programs must respond to the objectives of the country's development plan.

In the implementation of these programs, it will be very useful to standardize personnel policy by creating a central incentive fund for researchers.

Unification of agricultural research would avoid duplication, guarantee the coherence of policy on intervention at the rural level, and facilitate the coordination of activities between agricultural research and development organizations in transferring agricultural technology.

Research on animal husbandry is divided between two structures, the LCV (veterinary research) and the INRZFH (zootechnical research). A unified structure for coordination, programming and evaluation for this activity, which is so important to the animal husbandry sector, does not exist.

The success of the development effort required in the rural context depends essentially on the dynamism of the research and its capacity to generate technology adapted to and accepted by the rural population.

The animal husbandry research results will have no impact without effective health procedures for the livestock. These procedures are not possible without effective applied veterinary research.

It is, therefore, high time to avoid such dispersion of activities and to plan to harmonize all the agricultural research activities.

#### IV. TRAINING INSTITUTIONS

##### A. The Katibougou Rural Polytechnic Institute (IPR-Institut polytechnique rural de Katibougou)

###### 1. Sponsoring ministry

The ministry responsible for the IPR is the ministry for National Education.

###### 2. Resources and operations

The source of funding is the national budget, in the amount of FM 833,333,333 in investments on the average over the last three years, and FM 24,500,000 for operations, also on the average over the last three years.

The educational activities of the Institute focus on training engineers and senior technicians in the fields of agriculture, water and forestry, animal husbandry and rural engineering.

Diplomas issued are the following: senior technicians (agriculture, animal husbandry, water and forestry, rural engineering); and engineers in applied sciences (animal husbandry, agriculture, water and forests).

The fields of study which are taught include: agronomy, phytotechnics, zootechnics/animal production, veterinary medicine, forestry, and rural engineering.

Those who complete this training usually find career opportunities in government service in development operations or research services. A project to establish graduates from the IPR as private farmers is also being considered.

The admission capacity for each scholastic level is: 300 places for the Diploma of Basic Studies (DEF-Diplome études fondamentales) and 200 places for the Baccalaureate (biological sciences series).

The IPR's staff by level of position and type of training is shown in Table 21.

The recruiting needs for the next ten years will total 50 persons. The IPR's budget is insufficient for its needs, and therefore the institution is subsidized by the State.

###### 3. Principal assets

The principal assets of the IPR are shown in Table 22.

The library contains 3,000 books. The number of the new acquisitions each year is estimated at 100 books. The library is open every day (50 hours per week) and books may be borrowed.

Table 21: Human Resources of the IPR

<u>Cadres</u>	<u>Nationals (number)</u>		<u>Expatriates (number)</u>	
	<u>Full Time</u>	<u>Part Time</u>	<u>Full Time</u>	<u>Part Time</u>
Administration	17	0	0	0
Instructors	43	20	10	0
Instructors' Aids	30	0	0	0
Other (Experimental Farm)	62	0	0	0
Permanent Personnel in training	30	0	0	0

Table 22: Assets of the IPR

<u>Capacity</u>	<u>Area</u>	<u>Condition</u>
350 students (amphitheatre)	600 m <sup>2</sup>	Good
120 x 2	160 x 2 m <sup>2</sup>	Excellent
100 x 2	120 x 2 m <sup>2</sup>	Good
80 x 6	80 x 6 m <sup>2</sup>	Good
50 x 6	60 x 6 m <sup>2</sup>	Fair
30 x 8	30 x 8 m <sup>2</sup>	Fair
<u>Instruction Laboratories</u> <u>Area</u>	<u>Principal Use</u>	<u>Condition</u>
32 m <sup>2</sup>	Biochemistry	Good
24 m <sup>2</sup>	Microbiology	Fair
24 m <sup>2</sup>	Pedology	Fair
24 m <sup>2</sup>	Phytotechnics	Fair
24 m <sup>2</sup>	Hydrotechnics	Fair
<u>Other Areas</u>		
100 m <sup>2</sup>	Veterinary Clinic (consultation room)	Fair

The audio-visual accessories are composed of an overhead projector and a slide projector.

A 300 ha farming area is available for student practice. 120 ha are designated for cultivation of crops, 110 ha for pasture, and 50 ha for forest growth.

B. School for Veterinary Attendants (EIV-Ecole des Infirmiers Vétérinaires)

1. Sponsoring ministry

The ministry responsible for the EIV is the Ministry for Rural Development. Nevertheless, the EIV is attached to the National Direction of Animal Husbandry.

2. Resources and operations

There are two sources of funding: The EIV receives funds from the State budget, and has just received additional financing from the World Bank for the Education Project.

Major areas of instruction include the training of veterinary attendants, internships integrated with training, and advanced internships.

Diplomas are issued for veterinary attendants after three years of study.

The fields of study which are taught include agricultural extension, agriculture, animal husbandry, veterinary medicine and general training.

Graduates are veterinary attendants who are employed almost exclusively by the State in the national services for extension and research.

The EIV recruits young students by giving entrance exams during their 9th year of basic studies (DEF preparatory year) who have not always necessarily obtained the DEF diploma.

The admission capacity is 60 students.

3. Staff

The EIV staff is categorized by position in Table 23.

Recruitment needs for the next three years are 18 people.

4. Budget

The budget level (operations) is FM 10,800,000 of which

Table 23: Human Resources of the EIV

<u>Cadres</u>	<u>Nationals (number)</u>		<u>Expatriates (number)</u>	
	<u>Full Time</u>	<u>Part Time</u>	<u>Full Time</u>	<u>Part Time</u>
Administration	15	0	0	0
Instructors	4	20	0	0
Instructors' Aids	0	0	0	0
Other	5	0	1	0
Permanent Personnel in training	0	0	0	0

FM 8,000,000 has been spent; this is an average for the last three years.

There is no investment budget. All credits came from the national budget. At present, the EIV is receiving financing from the World Bank and has been able to construct new buildings at Sotuba. This project will get underway soon.

#### 5. Principal assets of the EIV

The EIV's principal assets are shown in Table 24. The library contains 700 books and can acquire 50 per year for the duration of the education project (the next five years). Twenty new subscriptions to scientific periodicals are also planned for the same period.

The audio-visual accessories include: one 16 mm projector, one 8mm projector, one tape recorder, one episcope and one microfiche reader.

This is therefore, a relatively well-equipped library. It is open to students during determined hours, for a total of about 40 hours per week.

Students also have access to a 10 ha farm on which to practice. The 10 ha are divided between crop land (2 ha) and pasture (8 ha).

#### C. Communications Training Center (ML II-Centre de formation communications)

##### 1. Sponsoring ministry

The Ministry for Rural Development is responsible for the center. The Center reports directly to the Director of the Mali Livestock II Project (ML II) and PRODESO (Project for the Development of Livestock in the Western Sahel).

##### 2. Resources and operations

Funding is provided by the national budget and USAID. The average amount (for the last three years) is FM 11,800,000 for operations. There is no investment budget.

The center offers instruction for rural extension agents. Eighteen livestock extension certificates are awarded each year.

The fields of study which are taught include animal husbandry, pasture management, communications, and agricultural extension.

Those who receive certificates usually work in livestock and rural development operations.

Recruitment for 30 places is carried out annually through competition among candidates who have completed their 9th year of basic studies.



Table 24: Principal Assets of the EIV

<u>Capacity</u> (classrooms)	<u>Area</u>	<u>Condition</u>
1 x 60 students	80 m <sup>2</sup>	Excellent
1 x 60 students	80 m <sup>2</sup>	Excellent
1 x 30 students	40 m <sup>2</sup>	Excellent
<u>Instruction</u> <u>Laboratories</u>	<u>Principal Use</u>	<u>Condition</u>
1 x 50 m <sup>2</sup>	Physics-chemistry	Excellent
1 x 50 m <sup>2</sup>	Biology	Excellent
<u>Other Areas</u>	<u>Principal Use</u>	<u>Condition</u>
1 x 200 m <sup>2</sup>	Veterinary Chemistry	Excellent

### 3. ML II staff

The Center's staff is categorized by position in Table 25.

A ten-year recruitment program is currently underway. Supplemental staff consists of eight persons.

### 4. Budget

Outside financing has been interrupted and the contribution from the national budget is insufficient.

### 5. Principal assets

Principal assets of the ML II are listed in Table 26.

The library contains 300 books and 10 scientific periodicals and journals. It averages 50 new acquisitions each year.

The library is open approximately 48 hours per week.

Audio-visual accessories for instruction include: one 16 mm projector, one slide projector, poster photos and cassettes and one overhead projector.

The farming area intended for student practice totals 48 ha, which are used for vegetable crops. Mali Livestock II uses the Animal Husbandry Research Center's pastures.

## D. Tabacoro Center for Forestry Training (Centre de formation pratique forestier de Tabacoro)

### 1. Sponsoring ministry

In the forestry sector, in addition to the IPR at Katibougou, there is a single training institution attached to the National Direction for Water and Forestry, which in turn is attached to the Ministry for Rural Development.

### 2. Financing

There are two sources of financing: the national budget with an outlay of FM 3,500,000, used to equip the students (uniforms and accessories); and aid from Switzerland through the Forest Project for the Sikasso Region. The investment budget is FM 71,000,000 per year and the operating budget, FM 32,000,000 per year.

This institution trains, over a period of three years, beginning at the DEF (BEPC) level (diploma not required), technical agents who will be employed by the National Direction for Water and Forestry, according to its needs.

Table 25: Human Resources of the ML II

<u>Cadres</u>	<u>Nationals (number)</u>		<u>Expatriates (number)</u>	
	<u>Full Time</u>	<u>Part Time</u>	<u>Full Time</u>	<u>Part Time</u>
Administration	1	4	0	0
Instructors	4	4	-	-
Instructors' Aids	2	0	-	-
Other (support)	27	0	-	-
Permanent Personnel in training	0	0	-	-

Table 26: Principal Assets of the ML II

<u>Capacity</u> (classrooms)	<u>Area</u>	<u>Condition</u>
30 places	50 m <sup>2</sup>	Good
100 places (as of now)	200 m <sup>2</sup>	Excellent
<u>Instruction Laboratories</u>	<u>Principal Use</u>	<u>Condition</u>
10 m <sup>2</sup>	Photo Lab.	Fair
115 m <sup>2</sup>	Multiple Use	Excellent
<u>Other Areas</u>	<u>Principal Use</u>	<u>Condition</u>
220 m <sup>2</sup>	Offices, Dormitories	Fair
1100 m <sup>2</sup>	Warehouses	Excellent
1 villa	Director's Quarters	Excellent

The disciplines taught are the following: arithmetic and geometry, hygiene, health and first aid, agronomy, pre-military training, forestry, mechanics, fishing, French, botany and dendrology, forest protection, forest utilization, cultivation, forestry engineering, hunting, rural extension and soil conservation.

The goal and ideal of the training program is to obtain 1/3 theoretical training and 2/3 practical training.

The institution is operational, but is only two years old, so no diplomas have yet been issued. There are two classes (1st year and 2nd year) with 25 students each.

3. Tabacoro Center staff

The Tabacoro Center staff is listed in Table 27.

A five-year recruitment program was established for six supplementary specialists in pedagogy. Seven specialists have already been recruited through internships.

4. Principal assets

The principal assets are: two classrooms (provisional) in good condition; and a library containing 100 volumes, 10 scientific periodicals and journals and an overhead projector.

Fifty hectares of forest for application purposes, a sorghum and corn plot covering 1 ha, vegetable garden covering .5 ha and an additional area of .5 ha are available for student training purposes.

E. Division of Technical Agricultural Instruction and Professional Training

1. Sponsoring ministry

The Division of Technical Agricultural Instruction and Professional Training is a service reporting to the National Direction of Agriculture of the Ministry of Agriculture.

2. Objectives and operations

The Division provides basic technical agricultural training in Mali. Its activities are conducted in the following training centers:

- o Agricultural Apprenticeship Center (CAA) at M'Pessoba;
- o Agricultural Apprenticeship Center (CAA) at Samako;
- o Agricultural Apprenticeship Center (CAA) at Samé (centers for agricultural improvement and extension);

Table 27: Human Resources of the Tabacoro Forestry Center

<u>Cadres</u>	<u>Nationals</u> <u>(number)</u>		<u>Expatriates</u> <u>(number)</u>	
	<u>Full</u> <u>Time</u>	<u>Part</u> <u>Time</u>	<u>Full</u> <u>Time</u>	<u>Part</u> <u>Time</u>
Administration	2	-	-	-
Instructors	7	2	-	2

- o Rice Cultivation Center at Dioro;
- o Vegetable Cultivation Center at Baguineda; and
- o Food Crops and Groundnuts Center at Kita.

The training programs in the CAA's cover the following disciplines: agriculture, economics, extension, topography, botany, animal husbandry, agricultural mechanics, and general instruction.

The specialized centers are training establishments in which students from the CAA who have completed their second year take more specialized courses on a specific crop system.

### 3. Staff (all centers)

Currently at the level of the Division of Technical Instruction and Professional Training there are the following instruction personnel: five engineers, 36 graduates of technology courses, 20 foremen, 22 veterinary attendants and monitors, seven technical assistants, and 89 other general staff, for a total of 179 persons.

### 4. Financial resources (all centers)

With the financial support of the World Bank and USAID, it has been possible to proceed with the funding of training and the renovation of certain centers, and to acquire additional instructional and boarding material.

The average annual budget for the last three years was FM 368,905,000 (national budget). Investments totalled FM 333,942,000 (World Bank) and FM 444,000,000 (USAID), for a total of FM 777,942,000. The outlay for operations was FM 368,205,000. The national government outlay into operations totalled FM 78,000,000. FM 290,894,000 were allotted for scholarships.

Students at the level of the Diploma of Basic Studies (DEF), equivalent to the BEPC (diploma not required) are recruited. Currently there are 194 students in the first year class, 175 in the second year class and 175 in the 3rd year class. Of this total of 544 students, 433 are boys and 111 are girls.

The institutions for research and extension provide training for students in the form of apprenticeships at the end of their studies.

The "extension and orientation research" section assures liaison with other researchers and extension services in order to keep up with and teach innovations.

Furthermore, demonstration and test plots (on soils, varieties of crop rotation, etc.) are available for student training.

After three years of training, students who have successfully

completed training obtain the Certificate of Professional Agricultural Aptitude (CAPA).

Public authorities provide career opportunities to all new graduates in the Ministries for Rural Development and Agriculture to serve in the research and extension organizations.

5. Evaluation of problems

The problems are primarily financial and material in nature. The operational allocations are insufficient to assure proper maintenance and operation of the centers.

The amount of scholarships awarded is too low to meet students' needs. Delays in payment have led to student complaints.

The automobile fleets, agricultural materials and all the equipment could not be refurbished through USAID and World Bank financing, and are thus quite inadequate dilapidated.

It must also be noted that a number of instructors have left the program in favor of more remunerative pursuits. This means that new instructors must be recruited and trained.

F. Agricultural Apprenticeship Center (CAA-Centre d'apprentissage agricole)

1. Staff

The M'Pessoba CAA staff is listed in Table 28.

Certain instructors find that they have few advantages in comparison with their colleagues in certain rural development projects and wish to improve their material conditions.

The CAA at M'Pessoba believes it can recruit personnel with the future extension of the center and in relation to the number of students to be trained.

As many as eight nationals may complete their training in the next ten years.

Eighty-five percent of the students are of rural origin, 15 percent are of urban origin.

2. Budget

The operations budget is approximately FM 50,000,000.

3. Principal assets

There are two classrooms in the Center which are in good condition. There is no training laboratory and no greenhouse.



Table 28: Human Resources of the M'Pessoba CAA

<u>Cadres</u>	<u>Full Time Nationals</u>	<u>Full Time Expatriates</u>
Administration	1	-
Instructors	13	1

The library, which can accommodate 20 students, contains nearly 416 workers and 76 scientific periodicals and journals. Audio-visual accessories include a projector and slides, an overhead projector, an opaque projector and a tape recorder.

The library is open every day except Sunday from 8:00 a.m. to 11:00 a.m. Books are loaned for one week and periodicals and journals, for two days.

The total farming area is 25 ha, of which 16 ha are used for food crops, 4 ha for fodder and .5 ha for vegetables.

#### 4. Evaluation of problems

The operations budget is insufficient. It is necessary to recruit and train new instructors to replace the instructors who have departed, often due to insufficient salaries. The facilities are not adequate for the needs.

The instruction program seems to be getting off to a good start. With foreign financing, the CAA at M'Pessoba will be able to obtain better equipment. This is still the only center which has not been renovated.

Improvements in teaching methods will influence the quality of future graduates.

#### G. Agricultural Apprenticeship Center

##### 1. Staff

The CAA employs two full-time administrators, one foreign and 14 national instructors, a general staffer and one employee still in training. (See Table 29.)

The instructors, like the students, live in the housing available at the Center.

One employee is in training (veterinary attendant). There is no recruitment program for personnel except when the Center has some means of extension.

Only one new staff member will return to his post during that time.

Grants to train employees are planned; however, the number of grants has not yet been determined.

Seventy-five percent of the students come from the rural population and 25 percent are of urban origin. These students recruited at the BEPC level have no linguistic problem as their training is provided in French.

The State provides grants, but they are insufficient. The grants

Table 29: Human Resources of the Samanko CAA

<u>Cadres</u>	<u>Full Time Nationals</u>	<u>Full Time Expatriates</u>
Administration	2	-
Instructors	14	1
Other	1	-
In Training	1	

would need to be doubled to help improve the students' work. The annual recruitment is nearly 35 students. The average number who successfully complete the program is approximately 33.

## 2. Budget and expenditures

The budget and expenditures of various centers were mentioned earlier. The operating budget (grants included) is approximately FM 65,000,000.

## 3. Principal assets of the CAA at Samako

The Center, which has been recently renovated, has four classrooms with a capacity of 30 students, each measuring 150 m<sup>2</sup>, and an agro-veterinarian lab measuring 138 m<sup>2</sup>. The library occupies 107 m<sup>2</sup>. The professors' lounge measures 166 m<sup>2</sup> and the infirmary, 88 m<sup>2</sup>.

The library contains approximately 400 books. It is open to the students during their free time. Audio-visual equipment includes an overhead projector, a slide projector, a 16 mm projector and a tape recorder.

The total farming area of the operation comprises 35 ha, 30 of which are devoted to crops and 5 to cowpeas for fodder.

## 4. Evaluation of problems

The operating budget is highly inadequate. The new personnel recruits all require additional training.

The support staff is difficult to recruit.

The facilities are excellent, but require some funding to become operational.

## H. Agricultural Apprenticeship Center at Samé (CAA)

### 1. Human resources

The personnel of the CAA at Samé is listed in Table 30.

The instructors must have more material security or some may leave.

No recruitment of additional personnel is planned. However, within the next ten years a certain number of instructors will have to be retained.

The socio-professional origin of the students is as follows: rural origin, 90 percent; urban origin, 10 percent.

### 2. Budget and expenses

The operating budget (student grants included) averages approximately FM 60 million per year.

Table 30: Human Resources of the Samé CAA

<u>Cadres</u>	<u>Full Time Nationals</u>	<u>Full Time Expatriates</u>
Administration	4	-
Instructors	14	1
Other	2	-

The Samé Center has been entirely renovated and equipped thanks to AID financing.

### 3. Principal assets

The Samé CAA has six classrooms, all of which measure 200 m<sup>2</sup> and are in excellent condition. The training laboratory also measures 200 m<sup>2</sup>.

The number of books in the library is estimated at 425. About 50 new acquisitions are made each year.

The audio-visual accessories include an opaque projector, an overhead projector, and a slide projector.

The library's documentation is available to students and instructors during their free time.

The total area devoted to the farming operation of the Samé CAA is 20 ha, of which 15 ha are used for crops, 4 ha for pasture and 1 ha for market gardening.

Nearly 30 students receive the Certificate of Agricultural Professional Aptitude each year.

### 4. Evaluation of problems

Most problems arise from the insufficiency of funding allocated and the difficulties in obtaining these funds.

The staff needs better training and more skills.

There is no classroom problem and the equipment is still new.

Currently the Samé CAA is well renovated but poorly equipped from the standpoint of materials and the automobile fleet. These materials must still be acquired and operated correctly to improve productivity.

#### I. Problems as Seen by Personnel

The total number permanent instructors is insufficient compared to the number employed part-time. At the EIV, only four of 24 instructors are permanent. At the Communications Training Center we have four permanent and four temporary instructors. Neither of these two centers receive technical assistance for instruction.

There are very few teaching assistants at the EIV.

At the IPR, there are only 59 full-time instructors, compared to 20 part-time. There are 30 teaching assistants and ten full-time expatriates.

There are no permanent staff in training at the EIV or the Communications Training Center. The IPR has 30 permanent personnel in training.

The service conditions which result from this offer little encouragement. The career prospects for the faculty are not good. This is due to the lack of an adequate training policy for training instructors. The conditions of advancement are also unfavorable; there is no policy of promotions for instructors, which could explain the small number of professionals who are willing to devote themselves to this work.

Nationals are more attracted to the rural development operations where working conditions are better (remuneration is higher).

At the Forestry Training School at Tabacoro, instruction is carried out in temporary facilities; this could be one of the reasons why the service conditions are still inadequate.

As regards the faculty, one should note:

- o The lack of policy for training instructors; other sectors (rural development operations, research) can more easily benefit from training grants and self improvement;
- o The insufficiency, indeed the total lack of operating and/or investment funds (only the EIV has recently received foreign support). The communications center recently experienced an interruption of financial support from USAID shortly after the completion of a new center;
- o The lack of qualified senior technicians because of difficulties in recruiting due to the lack of adequate material remuneration (no incentive bonuses). The same is true of junior technical personnel;
- o There are no serious problems with the facilities, except at the IPR in Katibougou, where classrooms have become increasingly crowded with the increased numbers of students. The EIV and the communications center have recently been equipped with new complexes. But it must be noted that this center cannot operate without outside financing; and
- o It is necessary to adjust the capacity and the number of students; the IPR is currently overcrowded and the equipment is inadequate at the training school at Tabacoro.

The major problems are: administrative delays in establishing permanent accommodations; the need for early supplementary training of junior technical personnel; and the inadequacy of the support staff for routine responsibilities.

## J. Links Between Research and Extension

The training institutions have very little involvement in training researchers and applying research results.

Instead, the research institutions participate in the activities of the training institutions. Some researchers teach courses at the IPR in Katibougou. The instructors learn of break-throughs and innovations through the researchers.

Unfortunately, there are currently no operational links between the research and training institutions, except in the case of a few researchers who teach part-time or correct students' term papers or theses. There is little use of research centers for practical applications.

Neither do the training institutions organize short-term programs for retraining or informing researchers, who are therefore obliged to go abroad to take refresher or retraining courses.

Research results are often not communicated to the training institutions; neither are these findings used in the courses to provide case illustrations for subjects which are often theoretical.

The extension institution participates in student training by providing work opportunities during vacations and their final semester internship (thesis preparation). Students can also go into the field with the extension services for demonstrations. The training institutions also organize refresher or retraining sessions in the extension operations.

For the time being, therefore, there is little or no liaison between the training institutions and the research institutions. On the other hand, through the rural promotion and extension course provided in certain training institutions, technicians are prepared to work in the extension services.

## K. Recommendations

It is necessary to improve the training institution capacity to accommodate new students, acquire more audio-visual equipment and library facilities, conduct an intensive training policy for instructors (improve the quantity and quality of the instructors), and adopt a policy of incentives for the instructors with improved salary levels and advancement conditions.

It is also necessary to improve the laboratory facilities, increase the number of instructors' aids to orient the student work groups, encourage researchers (from the research institutions) to give lectures, courses, etc., at the training institutions to provide information on research results, and raise the level of the operating budget for the training institutions and the amount of support for students (grants).

The improvement of training institutions over the next ten years requires:



- o Improvement in the quality of the instructors;
- o Supply of equipment to the laboratories;
- o Acquisition of complete audio-visual accessories; and
- o Recruitment of teaching assistants for the work groups.

It is also desirable to program one research institution internship per year in the laboratories or experimental farming operations.

Instructors must seek to train future development personnel adapted to conditions of production. Therefore, instructors should be informed of problems in the field and design the practical internships accordingly.

The number of graduates is much greater in the higher level schools. For example, the IPR trained 120 engineers and livestock technicians annually over the last three years, while the EIV issued only 50 diplomas per year. There is an anomaly in this. Indeed, there should be more students trained to work among the rural population under the current strategy.

In order to implement the new training strategy and to channel students toward the productive sectors and away from the civil service, where salaried jobs are becoming scarce, it will be necessary to establish a system of different stages of orientation into the various educational levels, so that young students may find work easier when they enter the job market. Further, it is imperative that the rural school system be extended throughout the countryside and that rural teaching be upgraded.

It is also necessary to pursue an in-depth planning policy designed to improve the educational system and the working conditions of the teachers.

## V. EXTENSION INSTITUTIONS

Following independence, Mali opted for a policy of decentralized administration. This is why the Regional Directorship for Rural Development (DRDR-Direction régionale du développement rural) was created at the regional level.

Faced with declining production, the government decided in 1964 to transform the country's agricultural agencies into more autonomous entities called programs, which operated in geographically defined zones rather than administrative units related to agricultural homogeneity. Thus, the Millet Program and the Groundnut Program were created.

In 1972, the Rural Development Operation (ODR) formula was arrived upon. This is an entity which operates in determined geographic zones, depending on the ecology, and which has a certain degree of administrative autonomy with respect to its material, human and financial resources. Its mission is to promote economic and social development in given zones, and to deal with technical problems related to agricultural credit, marketing agricultural products, construction of rural roads, functional literacy programs, human health, etc.

### A. List of Extension Institutions

The organizations, offices and operations for rural development which handle extension programs from within the Ministry of Agriculture are as follows:

- o Mali Textile Development Corporation (CMDT -Compagnie malienne de développement des textiles);
- o Niger Office - (ON-Office du Niger);
- o Rice Operation-Segou (ORS-Opération riz Ségou);
- o Millet Operation-Mopti (OMM-Opération mil Mopti);
- o Kaarta Integrated Development Operation (ODIK-Opération de développement intégré du Kaarta);
- o Baguineda Integrated Development Operation (ODIB-Opération de développement intégré de Baguineda);
- o Upper Valley Operation-(OHV-Opération Haute Vallée);
- o Integrated Development Office for Groundnuts and Cereal Production (ODIPAC-Office pour le développement intégré pour les productions arachidières et céréalières);
- o Flood Recession Action For Rice and Sorghum, GAO (ARS-Action riz sorgho de décrue Gao);

- o Lake Zone Operation (OZL-Opération Zone Lacustre);
- o Operation for the Senegal, Terekole and Magui Valleys (OVSTM-Opérations des vallées du Sénégal, Terekole et Magui);
- o Wheat Action, Diré (AB-Action Blé-Diré);
- o Sikasso Tea Operation (OBT-Opération thé Sikasso);
- o Selected Seed Production Operation (OPSS-Opération production de semences sélectionnées); and
- o Seed Production and Harvest Conservation Operation (OPSR-Opérations protection de semences et conservation des récoltes).

The location of each development office and operation within the Ministry of Agriculture is shown in Figure 11.

The offices and operations cover almost all of the agricultural zones in Mali. All zones which are not covered by their activities are considered zones out of operation.

We will focus on the information obtained from the offices surveyed. Difficulties were encountered, particularly in relation to details on institution budgets.

#### 1. The Niger Office

The Niger Office was established in 1932 to equip and develop the inner delta of the Niger River through irrigation. To this end a dam was constructed between 1934 and 1947 on the Marakala site.

In 1961, the Niger Office became a public industrial and commercial corporation organized under the State of Mali, functioning as an autonomous financial entity.

##### a. Major activities

The office was originally created to manage irrigated cotton production. Since then, cotton farming has been progressively abandoned in favor of rice cultivation and, after 1964, that of sugarcane.

Today, the Niger Office supplies more than 3/4 (about 80 percent) of the paddy rice sold and all of the sugarcane produced in Mali (about 33.3 percent of national requirements).

Its livestock operations are also significant in that they may lead to a better integration of agriculture and livestock production.

The production of fruits and vegetables as well as tobacco is of lesser importance.

b. Geographic and ecological zones

The activities of the Niger Office extend to the 4th and 5th administrative regions in the Sahel zone of Mali. Nearly 60,000 ha have been developed, 40,000 of which are being cultivated.

c. Financial resources

It has not been possible to obtain precise budget information related to extension. The average total budget of the Niger Office amounts to approximately FM 16 billion.

d. Staff

Fifty-one nationals work at the Segou headquarters. In the production zones and sectors, there are 2,576 and 343 national employees.

At the unit level, there are 96 full-time employees.

It must also be pointed out that the figures related to the sectors and the units are included respectively in those of the zones and villages (247).

Nine expatriate employees work full-time and five work part-time in the zones.

Finally, there are five expatriates employed in the electro-mechanical sector, 40 in the sugar industry and three at the headquarters who work on studies and programs.

Staff distribution is shown in Table 31.

There are 80 cadres in category "A" and 113 in category "B".

The majority of the management personnel are men; 15 women at the BEPC level with two years of training are employed by the Niger Office.

During the next ten years with the consolidation and extension of activities of the Niger Office, it will require nearly one hundred agents, 20 percent of these in category "A" and 80 percent with at least a Baccalaureate and four years of training.

e. Extension results

The results of extension include:

The Niger Office furnishes the staff with technical reports on extension themes.

Table 31: Breakdown of the Niger Office Personnel

<u>Personnel</u>	<u>Headquarters</u>	<u>Zones</u>	<u>Sectors</u>
Agronomists	7	33	29
Rural Works Engineers	1	12	12
Zootechnicians	1	3	3
Veterinarians		3	3
Horticulturalists	1		-
Crop Protection			
Economists	2	2	2
Financial Officers	4	1	1

Periodically it also distributes technical notes and bulletins on agriculture and livestock.

Small farmers are provided with basic extension training Monday through Thursday afternoons, through a system of solidarity groups.

Rural initiative sessions in the agricultural sectors are held periodically.

Newspaper articles are often devoted to rural extension and agricultural activities and their place in the national economy.

Sessions for extension workers are organized annually at the center for agricultural training at Niono. There are three to four retraining sessions for monitors per year.

Every Friday, employment courses are held in the agricultural sectors.

Cultivation techniques (replanting, weed control, etc.), varietal tests on fertilizer and crop protection products are carried out on demonstration plots and test fields.

Other office activities include involvement in:

- o Cooperative initiatives and village associations;
- o Reading and writing instruction;
- o Meat production; and
- o Fruit and vegetable development.

f. Research - extension liaison

The production and productivity objectives define the extension programs, which in turn indicate which additional research activities should be conducted. Research themes and requirements are decided upon in coordination with the national agronomic research structure, which establishes the protocols which the Niger Office then executes under its supervision. Research results appropriate for extension are available to extension workers in technical files.

All these activities are conducted within the Office by its agricultural service with the counsel of the Supplementary Research Division. Extension results are in turn communicated to the research institutions either by report or during the specialized technical meetings of the Scientific and Technical Committee of the IER-National Committee for Agronomic Research (Comité national de la recherche agronomique). Multisite varietal tests are also conducted by WARDA.

g. Problems as seen by the technical staff

The Niger Office is having difficulties in funding its investments and operations with respect to the defects in the hydraulic network and certain works and installations. In terms of staffing constraints, the insufficient training of the extension workers, and the inadequate logistical resources and materials must be noted.

Research problems are the result of inadequate resources to properly initiate and develop supplemental research. It is also necessary to coordinate research more fully with priorities.

Lack of motivation and illicit business practices are the primary stumbling blocks related to the small farmer's acceptance of new agricultural machines.

With respect to economic constraints, the essential problems are the general lack of adequate agricultural equipment and materials caused by ever-increasing prices of agricultural inputs and low prices for agricultural products. Farmers are also stymied by inadequate agricultural credit and the increasing size of their debt burden.

Finally, the large pre- and post-harvest losses (particularly associated with birds) must be noted.

2. Mali Textile Development Corporation (CMDT)

The Mali Textile Development Corporation was created in 1974 by an agreement between the Mali Government and the CFDT, which was designed to permit the continuation of the activities undertaken by the CFDT beginning in 1952 in the area of cotton cultivation. The CMDT has since extended its activities to agricultural production and livestock, as well as rural training and promotional operations. Its sponsoring ministry is the Ministry of Agriculture.

As a landless corporation responsible for the management of Malian property, the CMDT was given the mission of agricultural development in its target zone.

a. Major activities

In order for the CMDT to successfully carry out its mission as a rural development agency, the CMDT was given the following responsibilities:

- o Increase the production of cotton and all crops rotated with it, particularly millet, sorghum and corn, through bringing larger areas under cultivation and by intensification of cultivation methods;
- o Provide farmers with an efficient extension service and agricultural credit for the purchase of equipment and production inputs;

- o Improve integrated animal husbandry methods;
- o Develop a primary health program; and
- o Assure the training and literacy of the rural population through instruction to rural laborers and young farmers.

b. Geographic zone

The target zone confined to the CMDT extends over the second, third and fourth administrative regions, between the latitude 14° North and the borders with Upper Volta, Guinea and the Ivory Coast to the South.

c. Ecological zone

The CMDT activities are carried out between the Sudan-Guinea and the Sudan-Sahel zones, and include the Sudan zone.

d. Staff

Twenty-five cadres, including four expatriates, are employed at the Directorate level; 660 employees, including 12 expatriates work at the CMDT regional level. Another 221 work in other areas. Working conditions for all of the personnel of the CMDT are very satisfactory.

The CMDT also employs 40 agronomists, six civil engineers, two animal husbandry technicians, two veterinarians, six economists, one generalist, seven administrative personnel, 30 agricultural engineers, 78 agricultural monitors, 563 rural extension workers, one animal husbandry assistant, seven livestock engineers, nine veterinary attendants and 130 other persons.

Their education levels are as follows: ten employees with a baccalaureate degree and five years additional training; 41 employees with a baccalaureate and four years of training; 51 with a baccalaureate and two years of training; and 87 with a baccalaureate and no training. One hundred and forty-one employees have a BEPC Certificate. One employee is presently in training.

e. Extension results

Several types of bulletins and newsletters are produced and distributed, such as:

- o Technical notices and monthly results;
- o Extension worker memoranda;
- o Liaison and information bulletins; and
- o Monthly and annual reports.



Orientation meetings at the beginning of the project and during all critical periods are planned in order to facilitate the application of given techniques for particular crops. Frequent meetings with village associations are organized.

Several round-table discussions of agricultural issues have been broadcast on Radio-Mali. A number of articles dealing with similar topics have been published in a variety of newspapers.

Numerous training sessions are organized to discuss the priority problems identified in the previous crop year as constraints to a particular crop. These sessions are organized by region or by sector.

For example, in 1982, the technical issues identified for corn, now a full-field crop, were:

- o Soil preparation;
- o Planting dates;
- o Planting density;
- o Mineral fertilization; and
- o Organic fertilization.

For millet and sorghum, the issues were:

- o Preparation of soil and deep hoeing;
- o Seeding with seeder; and
- o Weeding and digging operations with a harrow.

The issues for rice were:

- o Ploughing;
- o Preparation of seed bed with a harrow;
- o Aerial planting, seedling planting; and
- o Manual or chemical weeding.

Many demonstration plots and test fields are farmed by the extension worker, who operates alone, but has recourse to research or agricultural mechanization.

There are many complementary activities:

- o 77 farms are equipped and operating;
- o A network of trained mechanics and craftsmen assures the

repair of agricultural equipment and the supply of spare parts (ploughs, carts, harrows, seeders and hoes);

- o Village associations have been set up to try to organize and involve the rural population in women's activities, human health programs, tests of gas tractors and biomass digestors, etc.;
- o Training of rural youth at six seasonal centers (reading and writing classes, instruction in agricultural techniques and secretarial training for the Village associations); and
- o Livestock operations (nutrition, animal feeding at the rural level, animal health, fertilizer stations).

Relations between researchers and the CMDT are excellent and worthy of emulation by many other development operations. Besides attending and contributing to research program orientation meetings, the CMDT often collaborates with researchers in farming test plots and demonstration fields.

Extension agents visit researchers to request advice whenever needed.

f. Problems as seen by the staff

There are no financing problems. There are good working links to research. The training service is properly carrying out its training mission. The targeted farmers have become more and more receptive to innovations.

A wealth of resources and the effective organization of transportation have helped remedy acquisition problems and delays in the arrival of production inputs.

The increase in the cost of agricultural inputs during 1981 forced farmers to cut their purchases to assure economic viability. The rate at which farmers are abandoning the purchase of agricultural inputs is correlated to the inputs' level of technicality and sophistication that is required to make a profit.

The decision to freeze the price of inputs for several years in order to maintain sufficient profit margins for the farmer has worked to allow the 1982 program to be successfully implemented.

Difficulties with levels of rainfall are the essential constraints to crop production in the CMDT zone.

Certain improvements are still necessary in order to better the latest programs' chances for success.

The extension of selected millet and sorghum seeds by the "Seed Production" operation is still in its tentative stages.

### 3. Rice Operation, Mopti (ORM)

#### a. Major activities

Controlled flooded rice cultivation in the Mopti region has been developing since 1964. The establishment in 1973 of the Mopti Rice Project I, and of the Mopti Rice Project II in 1978, were important in providing a source of training, agricultural credit, blacksmith and planting activities to farmers.

#### b. Geographic and ecological zones

Forty-thousand hectares of land have been prepared and distributed to about 12,900 farmers for rice cultivation principally on the right banks of the Niger and the Bani Rivers. The operation is situated in the middle of the Sahel zone. The system of rice production is single-crop.

#### c. Staff

There are 159 extension personnel operating at the zone, field and subdivision levels. Forty-two agents work at the Director's Office level. The distribution is shown in Table 32.

The education levels of the ORM personnel are as follows: one employee has a baccalaureate degree and five years of training; eight have the baccalaureate and four years of training; 33 have a baccalaureate and two years of training; 12 have only a baccalaureate; 52 have their BEPC and three years of training; 96 have a BEPC only; and 85 have less than a BEPC.

Two national employees are studying to attain a baccalaureate degree and four years of training.

#### d. Financial resources

We have been unable to obtain precise figures on the ORM's budget. According to estimates, 77.6 percent of the total operations budget is allotted to extension (including training, complementary research, etc.)

#### e. Extension results

The ORM distributes brochures to extension workers. It organizes periodic meetings in the irrigated- or sub-irrigated fields, depending on the operations which need to be performed. Radio-Mali and the local press, including the Peulh-language Kabaara newspaper, have been used to publish the extension efforts.

The ORM also organizes training sessions for extension workers in the hopes of acquainting them with innovative techniques.

Already nearly ten complementary research sites have been chosen for tests and demonstrations.

Table 32: Breakdown of the ORM Personnel

<u>Personnel</u>	<u>Direction</u>	<u>Zones</u>	<u>Fields</u>
Agronomists	6	-	-
Economists/Social Science	3	-	-
Agricultural Works Engineers (travaux agricoles)	10	-	-
Civil Engineering Technicians	1	-	17
Monitors	2	-	43
Technical Engineer/ Statistician	1		
Rural Extension Agents			
Foremen	4		96
Drivers	3		96

Finally, functional literacy and health instruction programs are also being developed.

f. Research-extension liaison

The ORM sends participants to the meetings and conferences of technical commissions specializing in research on rice. The organization is assisted with floating rice development by WARDA. The Division of Agricultural Mechanization (DMA) assists the ORM in the development of improved tools.

The Division of Agronomic Research is responsible for the field testing and control of selected seed production.

Finally, there is a complementary research sector within the operation.

g. Problems as seen by the staff

The most important problem relates to the operation of the budget. Personnel training should be improved, and efforts should be made to recruit more highly qualified employees.

4. Millet Operation, Mopti (OMM)

a. Major activities

The operation is oriented principally toward the production of millet and to a lesser degree, of vegetable crops.

In addition, a metal working program is carried out in order to help supply spare parts and agricultural equipment to farmers. There is also a functional literacy program.

b. Geographic and ecological zones

All operation activities are conducted at the farmer's level in the Mopti region (5th administrative region of Mali). The area is characterized by Sahelian climate and topography.

c. Staff

All OMM extension workers and administrators are Malian nationals who are full-time employees.

The personnel situation is shown in Table 33.

The OMM does not have any employees currently in training. The Operation's personnel needs are furnished by the National Direction of Agriculture.

d. Financial resources

USAID financed the OMM project until October 15, 1982.

Table 33: OMM Personnel

<u>Personnel</u>	<u>Headquarters</u>	<u>Sector</u>	<u>Agricultural Expansion Zone</u>	<u>Sector Base</u>
Agricultural Engineers	12	14	-	-
Agricultural Works Director (travaux agricoles)	3	-	22	-
Agricultural Works Engineers (travaux agricoles)	2	-	41	-
Civil Engineer	1	-	-	-
Agricultural Monitors	-	-	-	133
Rural Extension Workers	-	-	-	78
Blacksmith Trainer	1	-	-	-
Drivers	7	5	-	-

Since that time the project has received no other financial support except for some funds from the State budget to pay salaries.

The average annual budget is estimated to be: FM 498,000,000 for the national budget; FM 7,923,500 for previously planned investments in the amount of FM 179,423,500; and FM 37,670,000 for the project operations, financed through foreign sources.

e. Extension results

Detailed monthly reports and technical bulletins on operation programs have been published.

Regular orientation meetings are held to disseminate news of technical developments to extension personnel.

A number of functional literacy instruction and agricultural programs have been broadcast by the animal information section of Radio-Mali.

Functional literacy texts are compiled. Training and retraining sessions are regularly held at the extension work site by the training division. A training center has been opened in Boré for this purpose.

Finally, demonstration and testing fields have been set up to test the results obtained and proposed by agronomic researchers.

f. Research-extension liaison

The OMM provides assistance to the agronomic research support base at Seno and Koporo-Keniepe. Also, it cooperates with agronomic researchers and the joint Project 31 SAFGRAD in conducting pre-extension tests.

The OMM also participates in various specialized technical meetings, as well as in crop production conferences held by agronomic researchers. OMM staff also attend National Committees on Agronomic Research meetings.

g. Problems as seen by the staff

Since October 1982, the OMM has faced serious financial difficulties. It has had no investment budget, and the material operations budget has been inadequate to meet OMM needs.

The level of qualifications of the staff can be further improved through periodic short retraining courses.

There is no major problem with respect to access to the research results, especially when OMM is closely involved in the activity.

It must be noted that farmers are often reluctant to apply innovative techniques.

There should be no major problem if additional funds are required for the acquisition of production inputs.

The producer's prices must be supported given their low income, the excessively high price of agricultural inputs, and the climatic risks involved in farming (very frequent drought).

#### 5. Rice Operation, Segou (ORS)

The ORS was created by Regulation No. 59/PG-RM of May 19, 1972. Its goals are the socioeconomic development of the target zone, improved living conditions for the rural population, particularly those who cultivate rice.

##### a. Major activities

The operation is concerned essentially with promoting rice cultivation. Its objectives are to encourage the rational cultivation of the flood target zones, and to monitor all of the work upstream and downstream (maintenance, supply of inputs and agricultural equipment, services to farmers).

Other objectives include:

- o Development of village communities;
- o Literacy instruction;
- o Reforestation;
- o Well drilling;
- o Medical assistance; and
- o Livestock support.

##### b. Geographic zone

The Segou Rice Operation covers the 4th administrative region of Mali, with the exception of the irrigated perimeters managed by the Niger Office. Until 1982, it included a perimeter at San. At that time, the area was transferred to the Mali Textile Development Corporation.

The ORS zone thus currently includes 35,435 ha along the Niger River.

##### c. Ecological zone

The ORS district is situated in the Sudan-Sahel zone.



d. Staff

The ORS staff is constituted as follows:

- o Twenty-three agricultural engineers;
- o Two rural engineers;
- o Three Electro-mechanical engineers;
- o Thirty technology course graduates;
- o Forty-nine agricultural monitors; and
- o Ninety-four rural extension workers.

The educational level of ORS staff is as follows: four employees have a Baccalaureate degree and five years of training; 28 have a Baccalaureate degree and four years of training; four have a Baccalaureate and two years of training; 58 have a Baccalaureate only.

One national employee is now completing training and will have a Baccalaureate degree and five years experience; another in training will have a Baccalaureate degree and four years of training.

No recruitment program is planned for the next ten years. The two currently in training will resume their positions during that period.

e. Financial resources

The State provides funding for salaries.

The Segou Rice Operation has benefitted from two financing conventions with the EDF and the UNDP. This financing has permitted it to carry out its agricultural development operations and manage the reconstitution of seed stock (in 1981), the construction of a rice processing plant, guaranteeing access to farm plots, and the purchase of transport equipment and engines, threshers, etc.

f. Extension results

During the initial phases of the program, the ORS organized several orientation meetings for farmers. Numerous training programs on rice cultivation techniques were organized by WARDA for the extension workers. There are several demonstration and test fields which are farmed in collaboration with researchers.

g. Problems as seen by the staff

The most important problems for the ORS are those related to the staff's ability to overcome technical constraints (obtaining farming plots, maintenance, water supply, technical themes).

Under the plot distribution system, the allottee is usually unsure of his ability to continue farming his plot, and thus is not inclined to care for his land properly.

6. Integrated Development Office for Groundnut and Cereal Production (ODIPAC)

a. Major activities

In the context of extension and technical support, ODIPAC emphasizes millet, sorghum, maize and groundnuts and, to a lesser degree, cowpeas, rice, soybeans and sesame. Activities related to the feeding and management of draught animals have also received less emphasis. ODIPAC encourages small-scale development operations and rural roadways, in addition to equipping and assisting farmers in marketing their products. Finally, it provides education for women, literacy instruction, and other such programs for the rural population.

b. Ecological and geographic zone

ODIPAC is charged with an area comprising the Sudan zone to the Sudan-Guinea zone (Kenieba sector) in the first and second administrative regions of Mali.

c. Staff

Of the 130 agents working in the ODIPAC directorate, four are extension workers. The number of expatriates working full-time is five.

There are four extension workers at the zone level, 12 at the sector level, 35 at the sub-sector level and 165 at the basic sector level.

The educational level is as follows: one with a Baccalaureate degree and five years of additional training; 22 (two of whom are women) have a Baccalaureate and four years of training; seven have a Baccalaureate and two years; seven have a Baccalaureate and no additional training; 42 have a BEPC Certificate and two years of training; 17 have a BEPC only; and 380 have less than a BEPC.

Within the next two years, 18 new "A" level cadres and 24 monitors and extension agents will be needed.

d. Financial resources

The State contributes to the operations of the ODIPAC in the amount of FM 206 million. The World Bank credit agreement and the FAC convention contribute a total of FM 800 million for equipment and FM 700 million for operations.

e. Extension results

The Office issues nearly 100 technical bulletins per year. ODIPAC organizes visits between farmers from other areas and the ODIPAC zone, as well as regular village meetings by basic and sub-sectors. It also broadcasts a number of agricultural radio programs with the DNFLA and Radio-Mali.

Training sessions in the field, in the form of study meetings and trips for extension workers, are organized, as are meetings with the Directorship for agricultural mechanization.

Nearly 500 field demonstrations, 260 tests and 150 reproduction plot tests are conducted, and farmed, in order to determine varietal behavior.

f. Research-Extension liaison

Contacts between researchers and extension workers exist at various levels:

- o In the form of protocols, field tests, analyses of the results of tests and experiments by farmers;
- o Visits by researcher missions;
- o Visits to research sites by extension workers and farmers;
- o Participation in seminars, specialized technical commissions, sessions of the National Committee for Agronomic Research;
- o Information exchange with the sub-regional or international employees and institutes;
- o Informing researchers of extension needs; and
- o Efforts to apply the results of varietal research, fertilization, cultivation techniques, crop and stock protection.

g. Problems as seen by the staff

The essential constraint is associated with the need to keep the project viable. Continued support of agricultural input prices are required. Additional resources are needed to invest and continue operations.

Qualification and training problems for senior technical personnel could be at least partially resolved if certain organizational changes are made. Nonetheless, it will be harder to overcome problems caused by inadequate technical training among lower level personnel.

The major obstacles that extension workers encounter when trying to obtain research results are lack of communication and poorly or too-technically written summaries which are difficult to apply or understand.

The farmers have been very cooperative despite the setbacks and difficulties in extension, and despite the fact that they have yet to see many benefits.

With respect to pricing, it must be noted that input prices are often too high, and agricultural product prices too low. Staff salaries are too low.

The more serious problems for ODIPAC are the debts and liabilities incurred by the previous groundnut and food crop operation.

#### 7. Baguineda Integrated Development Operation (ODIB)

Created in 1972 from the former state farm, ODIB's principal goal is the rehabilitation of the old irrigated fields (4,500 ha). Organized under the National Directorship for Agriculture, its sponsoring ministry is the Ministry of Agriculture.

##### a. Major activities

In the outlying ODIB areas, vegetable crops are grown in the dry season (peppers, tomatoes, watermelon, okra, eggplant etc.) and cereal crops are cultivated in the rainy season (rice, maize, millet-sorghum). Mangos are produced in the orchards of the perimeter.

##### b. Geographic and ecological zones

The ODIB is situated in the Baguineda district (30 km downstream from Bamako), which lies entirely in the Sudan zone.

##### c. Staff

The ODIB employs 127 full-time and 50 part-time employees. All the civil service employees are covered by the terms of public service work (even though the salary is considered inadequate, normal advancement occurs in all categories).

Because the operation does not receive foreign financing, there are no other benefits (bonuses, compensation).

All work is carried out at the operation's headquarters. There are seven agronomists, one veterinarian, 16 administrators, eight technology course graduates, four agricultural works directors, two engineering technicians, one civil and mining engineer, 15 agricultural monitors, and one treasury controller.

Their educational levels are as follows: two employees have a Baccalaureate degree and five years of training; seven (including one woman) have a Baccalaureate and four years training; 14 have a Baccalaureate and two years; four have a Baccalaureate only; 25 (including one woman) have a BEPC Certificate and two years of training; and 35 have a BEPC.

Two employees are presently in training (one engineer and one technician). It will be necessary to train 36 additional personnel in order to respond to future needs.

d. Financial resources

The average equipment budget is FM 6,000,000; the operations budget usually totals approximately FM 145,000,000.

e. Extension results

The ODIB regularly distributes technical bulletins. It also conducts regular meetings with farmers during all critical application periods of given technical practices for crops cultivated in the perimeter.

A number of agricultural radio broadcasts are produced in cooperation with the DNAFLA.

Extension training sessions are conducted in the field. The same is true for the tests at the farmer's level.

In addition the operation organizes training activities for farmers, functional literacy instruction, and community development programs.

f. Research-extension liaison

The ODIB participates in the various seminars and meetings organized by researchers. Tours of research facilities are arranged for extension workers and farmers.

g. Problems as seen by the staff

The ODIB no longer receives any foreign funding, and state financing is largely inadequate.

Many young employees need additional practical training.

Relations with the research sector are good. However, there is room for improvement in the implementation of technical innovations.

The low producer prices and high costs for agricultural inputs seriously affect production.

Beyond the problems already mentioned, the following must be noted:

- o A decrease in the capacity of the irrigation canals due to the completion of the Sotuba Dam;
- o An increase in leakage caused by the poor condition and deterioration of the irrigation installations;
- o Deterioration of drains and roads which hamper agricultural production during the rainy season; and
- o The lack of adequate labor in relation to the arable portions of the perimeter.

8. Prodeso-Kayes North

a. Major activities

The pastoral region of Kayes North comprises part of the Western Sahel Livestock Development Project and is sponsored by the Ministry for Rural Development which delegates its powers to the National Director for Livestock. The project's principal activities consist of pasture management marketing and promotion of livestock production, maintenance of herd health, and rural extension and promotion.

b. Geographic and ecological zones

The project (Prodeso) is based in Bamako. Project administration at the field level is delegated to zone leaders, including the pastoral zone of Kayes-North. The zone leader is assisted by section leaders for administration and finance, pastoral development, animal health and production and extension.

Geographically, the pastoral zone of Kayes-North extends into the 1st region (Kayes) and corresponds to the Sahel ecological zone.

c. Staff

The human resources are divided as follows (by level of responsibility and by discipline):

- o At the national level, there is one part-time, expatriate rural engineer;
- o At the regional level there are three agronomists, one rural engineer, seven animal husbandry specialists, two economists (social services), two administrators and two forest engineers;
- o At the department level, there are 14 mid-level veterinary agents, veterinarians assistants, livestock technologists, and four veterinary attendants;

- o At the district level there are 21 veterinary agents (IV, ITE, AT); and
- o At the village level there are 24 extension workers (basic junior agents). The village is the smallest management unit.

The educational level is as follows: two men have a Baccalau-reate degree and five years of additional training; 12 men have a Baccalaureate and four years of training; three men have a Baccalaureate and no additional training; eight men have a BEPC Certificate and two years of training; 26 men and one woman have a BEPC Certificate and no training ; and 24 men have less than the BEPC.

No agents are currently in training.

It will be necessary to train 39 additional personnel in the next ten years.

d. Financial resources

Project funding comes from the Saudi Development Fund (FSD) and the national budget.

The extension budget totalled an average of FM 114,276,000 over the last three years.

e. Extension results

The results of extension are as follows:

- o Distribution of technical bulletins to extension workers on the following topics: brush fire fighting, continued extension, extension of the plan to manage 15 pilot villages, improved health protection of the livestock, orientation and motivation of the population through herders' committees, extension of animal feeding at the farmer's level, extension of farming practices related to the rational management of pastures;
- o Frequent farmer conferences in the village centers created for this purpose;
- o Better public understanding of conservation measures and requirements through airing of radio programs;
- o Training of extension workers through the use of educational films on animal production, protection of the environment, pasture and herd management; and
- o Organization of the herders in order to encourage their active participation in the project activities.

f. Research-extension liaison

No functional relationship currently exists between this extension institution and the research sector.

g. Problems as seen by the technical staff

Project problems as seen by the technical staff (zone directors) include:

- o Delays in meeting financial obligations and the system of releasing funds;
- o The senior technical staff's lack of knowledge about farming techniques applied in similar zones;
- o The inability of the junior technical personnel to appreciate the goals behind project activities;
- o The low level of remuneration of the service personnel who, as a result, are insufficient;
- o The cumbersome administrative practices necessary to gain access to research results;
- o The discouragement of farmers given the delay in the construction of basic infrastructure, particularly construction of the wells which were to have been built;
- o The lack of research on topics vital to the production zones; and
- o The lack of a clear animal production policy, the absence of forward-looking research on animal production structures, the lack of functional links between research, training and development.

9. East Nara Pastoral Zone of the Livestock Development Project in the Western Sahel (Prodeso-Nara East)

a. Major activities

The Nara-East Project is sponsored by the Ministry for Rural Development which delegates its powers to the National Director for Livestock. Nara-East is an integral part of the Prodeso project which has its headquarters in Bamako, and is therefore administered by the Prodeso zone leader.

The major activities concern the promotion of livestock production in Mali, pasture development, health, management of livestock and extension.



b. Geographic and ecological zones

Geographically, the zone straddles the 2nd and 4th regions of the country and covers the Nara and Nioro Circles, and the Nara Central, Guire, Sokolon and Nampala districts.

Ecologically, it is a Sahel zone (Western Sahel).

c. Staff

The staff is distributed as follows:

- o At the district level where the zone headquarters are located: one agronomist, two animal husbandry specialists, ten medical attendants and veterinary assistants, two economists/social services, two administrators, and three forest engineers; and
- o At the village level, there are 12 low-level extension workers.

The educational level is as follows: four men and one woman have a Baccalaureate degree and four years of training; six men have a BEPC Certificate and two years of training; three men have a BEPC and one year of training, and 18 employees have less than a BEPC.

There are no employees currently in training.

The number of additional persons who should be trained within the next ten years is 46.

d. Financial resources

The resources come from the sponsors (FSD-FAO-FAC) and from the Mali State Budget. The budget devoted to extension is estimated at about FM 106,000,000, or 3 percent of the overall budget of the project.

e. Extension results

The results of extension are summarized as follows:

Thirty-eight technical bulletins dealing with animal production techniques (pasture management, herd management, vaccination extension, food) were produced and distributed to the extension management during the last four years.

Over the course of four years, 1,996 farmers' meetings and 7,148 herder visits were organized and have dealt with the following themes: health coverage; parasite removal; use of potassium nitrate; protection and testing of pastures; reforestation; hydraulic construction; family economy, and storage of straw.

A radio program on the improvement of livestock in collaboration with the herders was produced and broadcast (for the four years).

Three training sessions were held for extension managers dealing with animal production techniques.

f. Research-extension liaison

The links existing between Nara-East and the research sector consist of research support in the form of scientific reports and publications made available for seminars and courses.

g. Problems as seen by the staff

The problems as identified by the staff are the following:

- o Delays in carrying out projects and insufficient annual investment and operation budgets;
- o The lack of senior-level specialized managers, and of a continuous training program within the project, a shortage of junior technical personnel, and the lack of senior-level managers;
- o The scientific isolation of the project staff due to their physical distance from headquarters and the lack of an equipped library;
- o The alienation of livestock producers as a result of the failure to produce the infrastructure promised by the project. There has been a certain indifference on the part of the producers in response to the extension actions proposed;
- o The almost complete lack of production inputs;
- o The lack of regular information on research due to the isolation of the Nara-East zone;
- o The lack of policy in regards to the principal inputs; and
- o Morale problems among the staff due to the lack of adequate incentive policy (bonuses).

10. Dilly Pastoral Activities in the Mali Livestock II Project-ML II (APS Dilly)

a. Major activities

APS Dilly is sponsored by the Ministry for Rural Development, which delegates its powers to the National Director for Livestock.

The APS was created as part of the MLI II project, and is administrated by the same director as the Prodeso project. The major activities concern the promotion of livestock production, pastoral development, irrigation and well development, health management of livestock, and rural promotion (extension, reforestation).

b. Geographic and ecological zones

The geographic zone of the APS covers 1,500,000 ha within the Dilly district; one section of the central district of Nara, one section of the district of Mourdiah de falou, Balle and Dioumara.

The ecological zone is that of the Western Sahel.

c. Staff

The staff is distributed as follows:

- o At the district level of Dilly (where the office of the Activities Director is located): one agronomist, one G.R. engineer, one veterinarian, two administrators, two managers, four veterinary attendants, and one stock manager; and
- o At the village level, the subordinate personnel, comprised of 16 extension workers.

The level of training is as follows: one man has a Baccalaureate degree and five years of training; one has a Baccalaureate degree and four years of training; two men have a BEPC Certificate and four years of training; four men have a BEPC Certificate and three years of training; and 16 men and two women have less than a BEPC.

The number of persons in training is three--one man will have a Baccalaureate degree and five years of training; one will have a Baccalaureate degree and four years; and one will have a BEPC.

The additional number of persons who should be trained during the next ten years is five.

d. Financial resources

The source of financing is the national budget. Assistance from USAID was cut in 1982. The budget devoted to extension (average for three recent years) is FM 20,130,000.

e. Extension results

The results of extension include the following:

- o Distribution to producers of technical bulletins dealing with the following themes: distribution of molasses; control of brush fires; animal castration; maintenance of water stations; use of potassium nitrate, breeding seasons;

vaccination of livestock; hay harvests (graminaceae, groundnut leaves and cowpeas), vegetable gardens; vaccination of children, promotion of nutrition, water filtration and pasture management;

- o Three meetings per month and per manager were held with committees of livestock producers; various orientation meetings on breeding techniques were also held;
- o Three radio programs devoted to extension themes, the management of pastures, and fire fighting were broadcast, and one film (fire fighting) was produced and shown;
- o Several seminars for retraining extension workers were organized; these dealt with health, management and livestock production, pasture management and marketing; and
- o Five test fields of 1 ha each are used to test the germination of trees and the production capacity of pastures.

f. Research-extension liaison

Relations between APS and the research sector are geared toward:

- o The development of test procedures in cooperation with researchers;
- o The joint analysis of data;
- o Support for extension worker training; and
- o Research support for the documentation of the APS.

g. Problems as seen by the staff

Problems as seen by the technical staff (Director) include:

- o Lack of adequate foreign financial support;
- o Lack of qualified managers;
- o Difficulty in obtaining access to research due to lack of resources;
- o Progressive discouragement of livestock producers due to the slowdown in project activities caused by the interruption of financing;
- o Lack of production inputs; and

- o Lack of regular information on research due to the geographic isolation of the project.
- 11. Integrated Development Operation of Kaarta-Livestock Division (ODIK)

- a. Major activities

The ODIK Livestock section is sponsored by the Ministry of Agriculture.

Its major activities involve raising young animals for meat, leather and milk production, extension of health practices for rural livestock, extension of the animal husbandry practices and pastoral development, development and management of pastoral species in the Balle district.

- b. Geographic and ecological zones

Geographically, ODIK covers a part of the 1st and 2nd regions, including all of the Circle of Niore and part of the Yelimane, Bafoulabe, Kita and Nara circles.

ODIK is located in the Western Sahel and Sudan-Sahel ecological zones.

- c. Staff

The staff of the ODIK livestock section by level of responsibility and field of specialization are as follows:

- o Circle level (ODIK sectors and headquarters are located here): one agronomist, one animal husbandry technician;
- o District level (where ODIK sub-sectors are based): 18 subordinate veterinary employees (assistants, attendants, engineers); and
- o Village level (where ODIK and sub-sectors are located): 20 subordinate livestock extension agents.

The education level of these employees breaks down as follows: two men have a Baccalaureate degree and four years of training; four men have a BEPC Certificate and two years training; and 38 men have less than a BEPC.

No employees are currently in training.

The additional number of persons who should be trained within the next ten years is 12.

d. Financial resources

The budget devoted to extension of the livestock production activities is FM 5,921 for investment, and FM 75,844,332 for operations. Financing comes from donors (ACDI) and from the state budget.

e. Extension results

The results of extension include:

- o Distribution to extension workers of several technical bulletins: 60 bulletins on extension of hay conservation and storage, 60 bulletins on maintenance techniques for plough oxen, poultry raising and on epizootics;
- o An indefinite number of meetings with farmers on the themes cited above; and
- o A training session and field trips by managers to promote livestock production.

f. Research-extension liaison

There are currently no links between the Livestock Section of the ODIK and the research sector. The planned research component of the project has not yet gotten underway.

g. Problems as seen by the staff

The following problems, as seen by the technical staff, have been identified:

- o A few delays in the disbursement of funds;
- o Inadequate maintenance personnel;
- o Access to research results is difficult for extension workers because of the complexity of scientific publications;
- o Regular information on research is lacking; and
- o A national policy for utilization of agro-industrial by-products for the feeding of livestock is lacking.

12. Cattle and Meat Credit Bureau (ECIBEV)

a. Major activities

Placed under the sponsorship of the Ministry for Rural Development at the Bamako headquarters.

The major activities of the ECIBEV are the cultivation of fodder (millet, maize) for storage, the practice of intensive animal feeding in feed lots, and animal feeding at the farmer's level through extension of modern technologies, the organization of farmers and the issuance of credit.

b. Geographic and ecological zones

ECIBEV conducts its activities in the Bamako district, part of the 2nd and 4th regions, particularly the circles of Banamba and Segou.

The ecological zones included in ECIBEV's target areas are the Sahel zone and the Sudan-Sahel zone.

c. Staff

The staff distribution by level of responsibility and field of specialty is as follows:

- o At the national level (the Bamako headquarters): two veterinarians, one economist (social sciences); one administrator and two support employees;
- o At the circle level (department): two veterinarians (subordinate employees/ITE);
- o At the district level: four veterinarians (subordinate technical agents); and
- o At the village level: four veterinary employees (technical employees).

The educational level of the staff is as follows: two men have a Baccalaureate degree and five years of training; one has a Baccalaureate and four years training; two have a Baccalaureate and two years; 11 have a Baccalaureate only.

The number of persons (nationals) in training is four.

The number of additional persons who should be trained within the next ten years is 11.

d. Financial resources

ECIBEV is financed by USAID and the Malian Government. The budget devoted to extension of animal feeding at the farmer level amounts to FM 182,735,777 for 1983.

e. Extension results

The results of extension are as follows:

- o Three meetings per zone and per year on the themes of animal feeding at the farmer level; and
- o The development of a demonstration field for storage.

f. Research-extension liaison

Links between ECIBEV and researchers consist of scientific and technical support for research.

g. Problems as seen by the staff

Problems as seen by the technical personnel involve:

- o Delays in the system of allocating funds; and
- o The lack of adequate feed for the livestock in the absence of a policy for the use of agro-industrial by-products.

13. Southern Mali Livestock Development Project (South Mali Project)

a. Major activities

The South Mali Project is sponsored by the Ministry for Rural Development, which delegates its powers to the National Director for Livestock.

The major project activities are:

- o Animal feeding at the farmer's level (orientation);
- o Supply of plough oxen to the farmers (preparation and sales);
- o Health management of the livestock; and
- o Extension of livestock production techniques.

b. Geographic and ecological zones

The target zones are those of the Sikasso (entire), Segou (Tomanian, Bla, Baraoueli), and Koulikoro (Doila Circle) regions.

The ecological zone is that of the Sudan-Sahel and the Sudan.



c. Staff

The staff is distributed as follows:

- o At the regional level: five animal husbandry technicians; two veterinarians (doctors); four administrators; three subordinate veterinary agents (A.T. IV);
- o At the department level: 19 animal husbandry technicians, three veterinarians; two administrators; 21 ITE (agronomic technologists); 13 veterinary assistants (AT), 40 veterinary attendants (IV); and
- o At the district level: two animal husbandry technicians; 14 ITE, seven A.T., and 21 IV.

The education level of this personnel is as follows: five men have a Baccalaureate degree and five years of training; 25 men and three women have a Baccalaureate and four years; two men have a Baccalaureate and two years training; 21 men have a BEPC Certificate and two years of training; 35 have a BEPC and three years training; and 53 men and ten women have less than a BEPC.

One agent is currently in training.

The additional number of persons who should be trained in the next ten years is unknown.

d. Financial resources

The budget is provided by several sources: donors (EDF), the national budget, and the population. The average total amounts to FM 151,000,000 for investment and FM 71,400,000 for operations.

The extension budget was impossible to determine given the nature of the project, which does not permit extension activities to be analyzed individually.

e. Extension results

The results of extensions are:

- o One training session on the techniques of animal feeding at the farmer's level, lasting two weeks, was organized in 1979 for the subordinate field agents (A.T. ITE, IV);
- o The project has a test and demonstration field 1 ha in size on which tropical alfalfa is cultivated; and

- o The extension activities are disseminated in a way likely to be practiced by each agent during his rounds and visits. Extension themes have concerned the technologies for animal feeding at the farmer level, health protection, and animal feeding.

f. Research-extension liaison

Links between the project and research exist in the Central Veterinary Laboratory, which has conducted an epidemiological study in the project target zone.

g. Problems as seen by the staff

Problems as seen by the technical staff include:

- o Insufficient level of financing given the size of the project;
- o Lack of initiative among the senior technical personnel;
- o The attitudes of the livestock farmers varies widely;
- o The activities of animal feeding at the farmer's level suffer from a lack of available livestock feed (agro-industrial by-products); and
- o Lack of information on research.

14. Mali Textile Development Corporation (CMDT) - Livestock Division

The CMDT, a semi-private company, is sponsored by the Ministry for Agriculture. The Livestock Division is part of the CMDT. The budget is provided by donors (BDEA) exclusively for the Livestock Division; the amount (average for the last three years) is FM 458,146,904.

a. Major activities

The major activities concern the promotion of draught animals (ploughing oxen), meat (animal feeding at the farmer level), manure, extension of forage crops, and health management of the herd.

Geographically, the zone of the project covers all of the 3rd region, the San circles, Tominian, Kimparana in the 4th region and the Circle of Kioila in the 2nd region.

The ecological region is that of the Sudan-Sahel zones and the Sudan-Guinea zones.

b. Staff

The staff is distributed as follows:

- o At the regional level (where the Livestock Division headquarters are located): two veterinarians (doctors), and one veterinary assistant;
- o At the circle level: ten technical veterinary employees;
- o At the district level: 13 technical veterinary employees; and
- o At the village level: nine technical basic veterinary employees.

The staff's educational level is as follows: two men have a Baccalaureate degree and five years or more of training; 13 have a BEPC Certificate and three years training; two have a BEPC and two years of training; 12 have a BEPC and three years of training; and 12 have less than a BEPC.

No agents are currently being trained. Ten additional persons should be trained in the next ten years.

c. Extension results

The results of extension are:

- o Distribution of technical bulletins on animal feeding at the farmer level, pathology and trypanosomiasis;
- o Several meetings held with peasants on the following subjects: internal and external parasite removal; forage crops; fodder preservation; and use of agro-industrial by-products;
- o Broadcasts over Radio-Mali on the subject of rural extension, animal health and livestock production; and
- o Demonstration field for forage crops.

Links with the research sector take place on three levels: at the LCV level, support for laboratory diagnostics; and at the level of the test plot and cowpea reproduction farm at Soukoula and at the level of the DRSPR and the IER concerning research on organic fertilizer and livestock feeding.

d. Problems as seen by the staff

The problems noticed by the staff have all been minor. Several problems have been noticed in communicating certain livestock extension ideas to the farmers, who are essentially sedentary farmers without sufficient technical expertise. Also, a lack of agro-industrial by-products, such as livestock feed has been noted.

15. Rice Operation Segou (ORS)-Livestock Action

The Segou Rice Operation is sponsored by the Ministry of Agriculture. The livestock Action is part of the activities of this operation. The budget is subsidized by the Mali State and amounts to FM 600,000 for investment and FM 20,135,000 for operations.

The major activities involve the promotion of meat production (animal feeding at the farmer level) and the production of draught animals (extension to farmers for the maintenance of plough oxen) through extension of appropriate themes.

The operation is situated in the Segou region, a Sudan-Sahel zone.

a. Staff

The staff is distributed as follows: at the regional level, one animal husbandry technician; at the departmental level, three veterinary assistants and attendants and two vaccinators.

The educational level of the personnel is as follows: one man with a Baccalaureate and four years training; one man has a Baccalaureate and two years; four have a BEPC Certificate and two years of training; and two have less than a BEPC.

No agents are currently in training. The additional number of persons to be trained over the next ten years has not been determined.

b. Extension results

Extension results are as follows:

- o Distribution of technical bulletins on technology for animal feeding at the farmer level and the preparation and maintenance of plough oxen; and
- o Informational meeting for farmers on the subjects cited.

Research links exist with the Institute of Rural Economics, which provides technical and scientific support for those who write the technical bulletins.

c. Problems as seen by the staff

Problems as seen by the technical staff include:

- o Lack of foreign financing; and
- o Lack of livestock feed for the activities for animal feeding at the farmer's level.

16. Livestock Development Operation of Mopti (ODEM)

ODEM is sponsored by the Ministry for Rural Development, which delegates its powers to the National Director for Livestock. It is financed by the World Bank and national resources. The amount of the overall budget is FM 1,092,655,000 (1982 budget). The budget devoted to extension has not been determined.

The target zones are as follows:

- o Geographically, ODEM covers all of the 5th administrative region of Mali; and
- o From the ecological point of view, it covers the central delta of the Niger, a part of the Sahel zone in Mali.

The major activities are pasture development, irrigation and well development, restoration of pastures, development of forage crops, literacy instruction, rural promotion and extension.

a. Staff

The staff is distributed as follows:

- o At the regional level (where the operation headquarters are located), one agronomist, 12 animal husbandry technicians, three veterinary inspectors, one economist/social scientist, one generalist (with a masters in education), 14 administrators, one electro-mechanical engineer, and four subordinate veterinary employees;
- o At the departmental level: seven animal husbandry specialists, two veterinary inspectors, 29 veterinary employees (ITE, IV, AV); and
- o At the district level: 60 veterinary employees (IV vaccinator).

The educational level of the personnel is as follows:

- o Five employees have a Baccalaureate degree and five years of training;

- o 22 employees have a Baccalaureate and four years training;
- o 43 men have a BEPC Certificate and two years of training;
- o 29 men have a BEPC Certificate and four years of training;
- o 20 men have a BEPC Certificate and three years of training;  
and
- o Ten men have a less than a BEPC.

The number of personnel in training is one. The number of persons who should be trained in the next ten years is 143.

b. Extension results

The results of extension are as follows:

- o Discussion meetings organized with the village leaders on extension of agro-industrial by-products, fodder trees, bordering for the terrain, and control of brush fires;
- o Each month an article on agricultural extension appears in the newspapers;
- o At least two sessions per year are organized at the ODEM headquarters for the extension personnel; visits to the national institutions are organized by the staff;
- o Establishment of a 50 ha plot for experimentation on the regeneration of the bourgou, of which 15 ha have been cultivated; and
- o Establishment of community development activities to train herders and for literacy instruction.

Links exist between ODEM and the research sector at the animal husbandry research level, in order to carry out research on the rehabilitation of bourgou, cultivation in-station and off-station (a cooperation agreement is being prepared). Research links also exist with the LCV for investigations and veterinary research.

c. Problems as seen by the staff

Some of the problems as identified by the staff are:

- o The fact that the project is awaiting a second financing phase;
- o The senior technical personnel need ongoing training;
- o The pastures have deteriorated and lack water, there is less production of agro-industrial by-products; and
- o The funds allocated for the missions are insufficient.

Two extension institutions, the Mopti Fishing Operation and the Sikasso Forestry Project, both attached to the Ministry for Rural Development, are training the rural populations.

#### 17. Fishing operation

The Mopti Fishing Operation covers the regions of Segou, Mopti, Timbucktu and Gao, which belong in the Sahel zone of Mali. The extension goals are:

- o Dissemination of insecticide products;
- o Improvement of the methods of drying and smoking fish;
- o Control over the production and marketing of fish; and
- o Social activities (literacy instruction, mechanization, health and WFP products).

There are 63 administrative and extension agents, nine of which work at the zone level, 14 at the sectoral level, and 40 at the village level. The break-down by level of education is as follows:

- o Five staff have a Baccalaureate and four years training;
- o Ten staff have a Baccalaureate and two years training;
- o Two have a BEPC Certificate and two years of training; and
- o 46 staff have a BEPC only.

There is no recruiting policy in this institution due to current financial difficulties. The budget amounts to FM 215,000,000 for investment and FM 39,000,000 for operations. These resources come from the national budget, subsidies from the National Forest Fund, and the Operation's own resources.

Relations with the research structures became profitable in 1983, with the joint preparation of research protocols in order to obtain a better understanding of certain fishing practices.

#### 18. Sikasso Forestry Project

The Sikasso Forestry Project covers all of the administrative region for which it is named and is located in the Sudan-Guinea zone.

The extension efforts are related to:

- o Equipment of the nurseries;
- o Village reforestation; and

- o Education of the rural populations on the role of forests.

The extension unit consists of 79 employees (all men) and two expatriates.

The educational level is as follows:

- o 11 employees have a Baccalaureate and four years training;
- o 30 employees have a Baccalaureate and two years training;
- o 17 have a BEPC Certificate and two years of training; and
- o 21 have less than a BEPC.

A program to recruit 25 additional employees is planned for the next ten years.

The financial resources for investment are FM 185,000,000 and come from donors. With respect to operations, the budget is divided: FM 38,000,000 comes from the national budget and FM 160,000,000 from the donor.

At this time, relations between this project and the research sector are limited to contact for the purpose of preparing research protocols.

#### B. Summary of Responses on Staff Resources and Working Conditions

At the level of agricultural development operations livestock division, staffing is not adequate. In general, all of the personnel lack education in the area of extension. A certain need exists for the recruitment of new extension workers, as well as for training to cover current needs. Also, it must be said that personnel are insufficiently motivated to accomplish the extension tasks because of poor working conditions (lack of bonuses, insufficient mission funding).

#### C. Summary of Responses on Links Between Extension, Research and Producers

The links between researchers, extension workers and livestock producers are almost non-existent. Contact between the extension worker and the producer has not developed; the villages are not adequately organized. (No organized unit smaller than the village was found in any of the cases studied.) The average extension worker is insufficiently trained to encourage dialogue between the worker and the producer. There is no research division in any of the institutions seen. They all indicate that they have been kept poorly informed of research developments.

In the area of agronomy, production objectives and productivity define the extension program needs, which in turn indicate accompanying research to be conducted. The needs and subjects for research



are communicated to the national structures for agronomic research which prepare the protocols. Generally, the producers learn of research developments from the extension institutions, and attempt to employ the new methods.

D. Problems Identified by Technical Personnel

The principal problems identified by the personnel concern financing (interruption in foreign financing, inadequacy with respect to the scope of the activities), the discouragement of the producers in view of the delays in constructing promised infrastructure (drillings, wells, pumps) and the lack of policies providing incentives for animal production. Other problems include the cumbersome bureaucracy for the disbursement of budget funds; the lack of production inputs; scientific isolation of the extension workers due to the target zone management; and the lack of adequate funding for research into technical problems. The research programs do not seem to reflect the concerns of the extension workers.

In the area of agronomy, the extension institutions most often have problems in assuring investments and operations, given the defects in certain works and installations and the difficulties involved in renovation. In regards to personnel, the inadequacy of extension worker education and the shortage of logistical resources and materials must be noted.

In terms of economic constraints, the essential problems are the shortage of agricultural equipment and material due to the high prices of agricultural inputs, low production prices, the shortage of agricultural credit, and finally, the heavy indebtedness of a large portion of the farmers. The size of the losses before and after harvest (caused mostly by birds) must also be noted.

At the Sikasso Forestry Project, the nursery techniques have not been mastered and information on research is lacking. With respect to the Mopti Fishing Operation, there is a pressing need for financial support and training of technical personnel.

E. Recommendations to Improve the Extension Systems to Meet the Needs of Producers

In addition to the extremely unfavorable climatic constraints, the rural development operations must deal with socioeconomic constraints. The following suggestions are therefore made in this connection:

- o Appropriate financing for the extension institutions to permit them to meet more fully their objectives;
- o Improved training of extension personnel to raise their technical competence;
- o Intensification of their activities in their zone;
- o Redevelopment of technical practices;

- o Improvement of functional literacy programs;
- o Incentives for well-run farmers' associations;
- o Consolidation and extension of primary health care;
- o Flexible establishment of short-term and long-term credit for technical production inputs and equipment;
- o Economical use of fertilizers with natural phosphate bases;
- o Use of selected seeds for which production would be rigorously organized;
- o Increased flexibility in marketing;
- o Improved information on the markets;
- o Improvement in the supply of drinking water to the populations;
- o Creation of evaluation units at the operational level, in areas where they do not already exist;
- o Reinforcement of financial and administrative management structures;
- o Improved integration of livestock and agriculture with the forestry components;
- o Closer collaboration with research agencies;
- o Increased profitability for the rural development operations by increasing their participation in the processing and export phases;
- o The creation of favorable conditions for recruiting and retaining extension managers by improving their working conditions and advancement prospects;
- o Mastery of nursery techniques; and
- o Development of close relations with research.

In the areas of fishing, suggestions are:

- o Consistency of financial support; and
- o Continuous training for technical personnel.

#### F. Other Pertinent Comments

The notion of extension is rather confusing, particularly in the livestock sector. Officially, the livestock service is responsible for extension, but it is not organized and lacks adequate resources. A regional veterinary director's office (DRT Segou) was studied but the results were disappointing. It appeared that there is practically no contact between the producers and the extension agents. The extension agents essentially provide services in the area of animal health.

In the area of agro-forestry, the extension activities must be redefined.

The Mopti Fishing Operations must intensify the extension activities of the Central Niger Delta.

#### G. Inter-Institutional Relations (Research, Training, and Extension)

The level of efficiency in relations among the various research, extension and training services varies depending on the institution. If greater cooperation and collaboration have been observed in certain operations, such as the CMDT with research, then the very poor inter-institutional relations existing between other operations are all the more deplorable.

To obtain instruction of better quality and to disseminate much more technical, concrete, and less academic information, it is necessary to establish closer collaboration with the technical services having an interest in production. The collaboration between training institutions, research, and extension institutions must therefore be strengthened.

Generally speaking, inter-institutional relations (research, training and extension) can be described as follows:

- o The mission of the Scientific and Technical Committees for Agricultural Research, is to define research objectives and prioritize them according to the strategy of the national economic and social development plan. These committees are composed essentially of representatives from the research, training and extension institutions;
- o The extension and research institutions participate in training because they hire students and advise them in their preparation of theses and reports for the last cycle of their training; and
- o Many of the research and extension personnel teach part-time in the training institutions.

Theoretically, these relations should serve as a framework for veritable inter-institutional integration. But in practice, the links are still not very functional, for a number of reasons.

The meetings of the scientific and technical committees most often are attended by too many staff members. Those who represent extension are not always those who are in direct and permanent contact with the realities of the rural life. Consideration should be given to preceding these meetings with technical meetings at the regional level to better understand the problems constraining the mobilization of the extension practices.

The research departments often lack the resources to open experimentation branches outside the station at the rural development operations level. The training institutions lack sufficient personnel (in terms of both quantity and quality of permanent staff) to promote existing relations.

In the field of agro-forestry, there does not seem to be inter-institutional relations between training and extension. The Katibougou Rural Polytechnic Institute, which could have provided the ideal framework in this area with the theoretical presence of its training and research departments, is instead concerned with education and management problems. Research cooperates well with this establishment and makes a notable contribution to training and orientation of students. It would obviously be desirable and necessary for research institutions to be closely linked with national educational structures, thus having resources to promote development through extension and incorporating research findings.

## VI. CONSTRAINTS

### A. Survey Results of Constraints to Each Important Crop

#### 1. Millet-sorghum

It is difficult to disassociate the statistics for millet from those for sorghum since these two crops are often accounted for together.

In 1982, millet-sorghum covered 1,392,938 ha for a production of 793,026 metric tons, or an average yield of 560 kg/ha. The yields of sorghum were generally higher than those of millet. The cultivation of sorghum is practiced in the Sudano-Guinean zone, in the Sudano-Sahelian zone and in the flood-recession zones. The cultivation of millet is practiced primarily in the Sudano-Sahelian zones and the Sahelian zones since it is more resistant to drought than sorghum.

The principal constraints which have reduced their yield in recent years are:

- o The harsh climate;
- o The widespread rainfall deficit;
- o The uneven distribution of rain;
- o The relatively poor soil;
- o The moderate to severe invasion of plots by weeds;
- o The cantharides, which prevent the production of millet in the Kayes region (ODIK and OVSTM zones);
- o The number of attacks by birds varies from one zone to another;
- o The problem of varieties is evolving from poor to serious depending on the zones and is very often linked with the poor quality of seed; and
- o The weakened condition of draft animals at the beginning of the season.

Among the economic factors, prices, marketing and, above all, credit and subsidy problems are the major constraints. All the land belongs to the State which cedes it to whomever wishes to farm it.

Possible short-term yields range from 1,000 to 1,200 kg/ha. The additional area which could be cultivated is estimated at 100,000 ha. Possible long-term yields are from 1,200 to 1,500 kg/ha.

Short-term action to be taken can be listed as follows:

- o Selection of short-cycle varieties resistant to drought;
- o Introduction of new improved varieties;
- o Varieties resistant to disease and tolerant to insect attacks;
- o Resolve the problem of fertilization as an activity limited by the cost of agricultural inputs;
- o Subsidize prices for equipment;
- o Pest control;
- o Support producers' prices;
- o Research on animal traction; and
- o Improvement of storage conditions.

Long-term activities would be as follows:

- o Pursuit of activities begun in the short-term;
- o Research on production systems;
- o Intensification of fertilization by the reduction of input prices;
- o Introduction of high-yielding varieties;
- o Subsidize prices for agricultural equipment; and
- o Health and nutrition activities for draft livestock.

Short-term priorities in order of urgency are:

- o Market prices;
- o Access to investment and production credit;
- o Agricultural inputs;
- o Availability of labor; and
- o Access to markets

Long-term priorities in order of urgency are:

- o Market prices adequate to cover production costs;
- o Access to investment credit;
- o Agricultural inputs;
- o Availability of labor;
- o Access to markets; and
- o Viability of technical methods.

Among the ODR's surveyed, only the Mopti millet operation plans to recruit additional personnel to achieve its objectives.

## 2. Irrigated Rice

In 1982, for all varieties of rice, an area of 150,000 ha produced 129,000 metric tons per paddy. Irrigated rice is cultivated in the Sudano, the Sudano-Sahelian, and the Sahelian zones along the rivers. A little more than 70,000 ha were seeded in 1983.

The principal constraints to the production of irrigated rice are the same, even though they occasionally vary in degree depending on the zone. The climate is very unpredictable. The impact of precipitation during the last three years has been medium to strong. The annual quantity is low compared with the inter-annual average. The distribution is very uneven in terms of both space and time. The soils are generally well adapted to the cultivation of rice. They are very often difficult to work at the beginning of the winter season, particularly since during this period the animals are under-nourished and weak because of having endured a long drought period.

One of the essential problems constraining the production of irrigated rice is that of weed control. It is not rare to see fields abandoned because of wild rice. Attacks by disease and insects are relatively insignificant; but, on the other hand, attacks by birds, particularly the quela-quela, are extremely serious, especially in the zone of the Niger Office and result in enormous losses before and after the harvest.

There is no problem concerning varieties.

Depending on the zone, the extent of the labor problem is variable. An urgent need arises particularly during the plot maintenance phase, when the wild rice invades the plot. The ploughing difficulties at the beginning of the winter season, with the bulls weakened during dry season, have necessitated the search for palliatives, particularly the use of tractors for ploughing. Equipment adapted to conditions is also lacking.

The price factor is very important: inflation is rampant for agricultural inputs, yet prices paid to the producer for his produce remain low. It is also desirable to increase flexibility in the marketing system.

Agricultural credit is inadequate and increasing debt can be observed among a large number of farmers. For some time, the elimination of state subsidies has caused a considerable drop in the purchase of inputs and equipment. In the zones developed by the State, the plots belong to the State and are leased to farmers. The training of farmers through extension is indispensable although many are often open to innovation.

Possible short-term yields, assuming the high technology available in the country were used by the producers, would be nearly 1,700 kg/ha at the High Valley Operation and at the Segou Rice Operation, 2,000 kg/ha at the Baguineda Operation, and 2,500 to 3,000 kg/ha in the Niger Office zone. Correct planting for the winter season and the rise of the river are more determining factors.

The Niger Office can extend its areas to at least 500,000 ha and the Baguineda Integrated Development Operation to 2,190 ha. The High Valley Operation, on the other hand, cannot extend its area without additional development, and the Segou Rice Operation believes that in its current situation, with the untimely rise in the river and often no rise at all, the marginal zones of its rice fields must be eliminated. Long-term yields would reach four to five metric tons.

To overcome short-term constraints the following measures are necessary:

- o Readjust the size of the plots to human and material resources;
- o Regroup the farm plots;
- o Partition the plots according to contour lines;
- o Train farmers;
- o Furnish additional equipment;
- o Control the wild rice;
- o Conduct research on varieties for low-water levels;
- o Rigorously organize the production of seeds of high yielding varieties with support for the seeds;
- o Use appropriate herbicides;
- o Control grain-eating birds;
- o Use economical mineral fertilizer;



- o Research water needs;
- o Research early varieties with high yields;
- o Research production systems;
- o Reinforce complementary research;
- o Periodically test the fertility of the soils to improve them;
- o Follow the agricultural calendar closely; and
- o Use selected seeds.

In the long-term, the following measures must be taken:

- o Continue the activities already undertaken;
- o Diversify crops;
- o Better integrate livestock and agriculture;
- o Improve draft animals' condition;
- o Improve the agricultural credit system;
- o Organize off-season crops;
- o Use double-cropping; and
- o Increase the flexibility of marketing and promote local consumption of food produce.

Urgent short-term priorities are as follows:

- o Market prices;
- o Access to investment and production credit;
- o Agricultural inputs;
- o Availability of labor for the state-supervised operations to achieve objectives within the allotted time-frame;
- o Viability of the themes offered by extension; and
- o Access to markets.

Urgent long-term priorities include:

- o Market prices;
- o Access to investment credit;
- o Agricultural inputs; and
- o Availability of sufficient labor.

It is not necessary to recruit supplementary personnel to achieve short-term and long-term results for many of the operations studied; however, the Niger Office does need supplementary personnel.

### 3. Rainfed rice and lowland rice

Rainfed rice and lowland rice are primarily cultivated in the CMDT and ODIPAC zones. Areas seeded under this type of rice cultivation are on the order of 15,000 ha. The average yields are between 300 and 1500 kg/ha. These types of rice are grown in the Sudanian zone and Sudano-Guinean zone of the country.

The principal constraints reducing the yields of the producers during the last three crop years are the following:

- o The climate was severe;
- o Even though the annual rainfall quantities were average in 1980 and 1981, in 1982 they showed a deficit;
- o The distribution of rain was always very irregular;
- o In the CMDT zone, the soils are relatively well adapted to cultivation; however, in the ODIPAC zone, depleted soils are often found;
- o Weeds are one of the most significant constraints;
- o Attacks by disease and insects are of little to moderate significance while attacks by birds are of average significance;
- o It appears that more profitable varieties need to be found;
- o The labor problem is moderate to severe;
- o The problem of draft animals, especially weak oxen at the beginning of the agricultural crop year, is also moderate to severe;
- o Prices are low, although more profitable than other cereals;
- o The problem of credit is very severe in the ODIPAC zone;

- o The subsidies policy is poorly adapted to the problem;
- o There are no regulations governing land tenure; and
- o Agricultural labor must be trained to compensate for the seasonal exodus of workers.

Possible yields in the short term may be 1,500 kg/ha. Nearly 6,000 additional ha could be cultivated with the high technologies currently available. Possible long-term yields may be 2,000-2,500 kg/ha. Action to be undertaken in the short-term includes the following:

- o Varietal research;
- o Improvement of cultivation techniques;
- o Redistribution of plots according to contour lines;
- o Effective water management;
- o Agricultural inputs; and
- o Farming equipment.

Beyond the action already underway in the short term, the following long-term action must be taken:

- o Study of water requirements;
- o Development of better water control; and
- o Crop protection.

Short-term priorities are:

- o Access to credit;
- o Agricultural inputs;
- o Availability of labor when needed;
- o Access to markets; and
- o Application of themes offered by extension.

Long-term priorities are:

- o Market prices;
- o Access to credit;
- o Agricultural inputs;
- o Availability of sufficient labor;
- o Access to extension services; and
- o Access to markets and information on markets.

It is not necessary to recruit supplemental personnel to achieve the short and long-term results.

#### 4. Floating rice

Floating rice, which is cultivated primarily by the Mopti Rice Operation, covers nearly 27,000 ha out of the 40,000 ha which have been developed. The yields for the last three years have varied from 1,089 kg/ha in 1980 to 1,048 kg/ha in 1981 and 729 kg/ha in 1982. It is cultivated in the Sahelian zone, principally on the banks of the Niger and Bani Rivers. The constraints which reduced the yields for the last three years were:

- o The climate was extremely harsh;
- o Rainfall, in terms of both volume and distribution, has not permitted a normal rise in the river nor the rain necessary for the rice;
- o Many soils are not adapted to floating rice cultivation;
- o The invasion of the rice fields by rhizome wild rice (diga) or annual (sego) is also an essential factor in the drop in yields;
- o Disease and insects had a slight to moderate effect on production;
- o The animals are too weak at the beginning of the winter season to complete preliminary field work effectively;
- o Credit is a growing problem;
- o There is no land tenure problem; however, the extension of dammed areas cultivated with rice creates certain conflicts between livestock herders and rice growers;
- o Farmers must be monitored more closely in order to pass on the technical innovations; and

- o The rise in the river is the cause for failure of many fields.

Possible short-term yields are 800 to 1,200 kg. As long as the volume and the river level have not improved, it will be impossible to seed additional areas. Possible long-term yield is 2,500 kg/ha.

Action which should be undertaken in the short term includes:

- o Correct application of technical themes (ploughing, seed recovery, weeding);
- o Flexible and appropriate agricultural credit;
- o Organization of the rural milieu with transfer of certain responsibilities to the producers;
- o Higher performance through adaptable crop material;
- o Search for more versatile agricultural equipment;
- o Lowering of the water level to better secure the rice fields;
- o Partitioning; and
- o Use of selected seeds.

Long-term projects, beyond those already cited, are:

- o Maximum hydraulic security compatible with the advantages and disadvantages of the areas;
- o Supply appropriate crop material;
- o Frequency study of the river rise and rainfall;
- o Meteorological prevention service; and
- o Improvement of preventive human health service.

Priorities in terms of urgency (short-term and long-term) are:

- o Market price;
- o Access to investment credit and production; and
- o Availability of qualified labor.

The Mopti Rice Operation believes that it is not necessary to recruit supplemental personnel to achieve short-term and long-term results, but instead emphasizes training and specialization of personnel as an alternative to increasing its size.

## 5. Maize

In 1982 maize covered 74,000 ha for a production of 95,000 metric tons, or an average yield of 1,289 kg/ha. This is a crop which is cultivated wherever rainfall permits. The principal zones of production range from the pre-Guinean zone to the Sudano-Sahelian zone.

The principal constraints in its production are:

- o The harshness of the climate;
- o The volume and distribution of rainfall;
- o The soils, which are average to poor;
- o The crowding out by weeds;
- o Problems with monkeys and birds;
- o Agricultural work factors, which constitute only a moderate constraint;
- o Price, which constitutes a significant constraint;
- o Marketing;
- o Farmer training; and
- o Often, the quality of seeds.

Possible yields are 1,500 to 2,000 kg/ha. Nearly 50,000 supplemental ha could be seeded with corn. Long-term possible yields are in the 2,500 - 3,500 kg/ha range. Actions to take in the short-term are:

- o Varietal improvement, resistance to drought, short cycle, resistance to disease, particularly viral diseases which broke out this year in the CMDT zone;
- o Improvement of cultivation and harvesting techniques;
- o Fertilization;
- o Production of quality seeds;
- o Establishment of a viable marketing organization with price supports for producers; and
- o Organization of a system of credit for equipment and subsidies.

Actions to take in the long-term are:

- o Continuation of the above-mentioned activities;
- o Production of pure seeds;

- o Improvement of food technology (corn shellers, mills, preserving techniques);
- o Intensification of corn cultivation; and
- o Health and nutritional improvements for livestock.

Short-term priorities include:

- o Market prices to cover the production costs;
- o Agricultural inputs;
- o Access to credit;
- o Availability of labor to perform the work within the allotted time-frame; and
- o Access to markets.

Long-term priorities would be:

- o Market prices to cover production costs;
- o Agricultural inputs;
- o Assurance of property rights over a long period of time;
- o Access to and information on markets; and
- o Availability of labor to perform the work in the allotted time-frame.

The Baguineda Development Operation believes that it must recruit supplemental personnel (5 to 10 percent to achieve short- and long-term results).

## 6. Groundnuts

In 1982, Mali produced 48,000 metric tons of groundnuts on an area of 91,000 ha, for an average yield of 527 kg/ha. The groundnut is cultivated in Sudano-Guinean, Sudanian, and even Sahelian zones.

The principal constraints which have affected groundnut production during the last three years are the following:

- o Climatic difficulties;
- o Volume and distribution of rainfall;
- o Cultivation on soils which are often depleted;
- o Difficulties in controlling weeds;

- o Insufficient performance of draught animals;
- o Prices;
- o Liberalized marketing;
- o Lack of credits;
- o Lack of subsidies;
- o Distribution of land in certain zones; and
- o Quality of seeds.

Possible short-term yields could be 1,000 kg/ha. The supplemental area which could be cultivated is 65,000 ha. Possible long-term yields could be 1,500 - 1,700 kg/ha. Actions to take for the short-term are:

- o Varietal improvement;
- o Research on short-cycle, high-yielding varieties;
- o Extension of simple and inexpensive cultivation techniques (ground preparation, good planting date, seed treatment and hoeing);
- o Treatment (desertification and storage); and
- o Improvement of production systems.

Actions to take for the long-term are:

- o Varietal research with a seed service;
- o More advanced cultivation techniques (use of herbicides, fertilization);
- o Agricultural credit;
- o Cooperation between research and development;
- o Preservation of harvests;
- o Development of road and warehouse infrastructures; and
- o Training of extension agents.

Short- and long-term priorities may be listed as:

- o Market prices sufficient to cover production costs;
- o Access to investment and production credit;



- o Agricultural inputs;
- o Access to extension services;
- o Access to markets, particularly for isolated zones such as those ODIPAC; and
- o Viability of the subjects offered by extension.

#### 7. Cotton plant

The cotton crop was grown on 105,162 ha in 1982 for a production of 129,000 metric tons, or an average yield of 1217 kg/ha. It is cultivated essentially in the CMDT zones and High Valley Operation (Sudanese-Guinean and Sudanese).

The principal constraints which have affected its production during the last three seasons were the following:

- o The severity of the climate;
- o Volume and distribution of rainfall;
- o Prices;
- o Import policy;
- o Control of weeds;
- o Marketing (limitation of the percentage of choices imposed);
- o Credit;
- o Weakness of draught animals at the beginning of the winter season; and
- o Need for farmer orientation.

Possible yields in the short term could be 1,300 - 1,400 kg/ha. The supplemental area could be 35,000 ha, and long-term yields, 1,500 - 2,000 kg/ha. Short-term action to be taken is:

- o Varietal improvement (productive varieties well adapted to the climatic conditions);
- o Technical factors of production;
- o Monitoring of changes in soil fertility under various production systems;
- o Technical systems of production with medium-scale mechanization;
- o Credit;
- o Phytosanitary protection;
- o Increase in the prices received by the producer; and
- o Stepped up use of organic fertilizer.

Long-term action to be taken beyond the actions listed above are:

- o Phytosanitary protection;
- o Technical factors of production;
- o Subsidized fertilizer costs;
- o Health protection and nutrition of livestock;
- o Socio-professional extension to the rural population; and
- o Agriculture-livestock integration.

Short-term priorities include:

- o Market prices sufficient to cover production costs;
- o Access to investment and production credit;
- o Agricultural inputs;
- o Availability of labor to accomplish objectives in the allotted time-frame; and
- o Access to markets and information on markets.

Long-term priorities include the following:

- o Market prices sufficient to cover production costs;

- o Access to equipment and production credits;
- o Agricultural inputs within appropriate time-frame;
- o Availability of labor; and
- o Access to markets and information on markets.

It is not necessary to recruit additional personnel to achieve long- and short-term results.

#### 8. Sugarcane

Sugarcane is cultivated by the Niger Office, under State supervision. The current area covered by this crop is 2,279 ha and the yields obtained during the last three seasons are respectively: 84,100, 61,000 and 59,390 metric tons/ha. It is cultivated in the Sahelian zone.

The principal constraints which have affected its production during the last three years were:

- o Soil depletion;
- o Weeds;
- o Disease;
- o Labor;
- o Prices;
- o Volume and distribution of precipitation;
- o Parasites;
- o Marketing;
- o Credit; and
- o Subsidies policy.

Possible short-term yields could be 70 metric tons/ha. The additional area which could be seeded is 30,000 ha. Long-term yields could be 90 metric tons/ha.

Actions to take in the short term include:

- o Development of techniques to improve soil structure;
- o Reinforcement of research on phytosanitary control; and
- o Determining optimal methods for water management.

Long-term actions to take include:

- o Further development of the themes enumerated above;
- o Varietal improvement;
- o Maintenance of cane over a period of time;
- o Maintenance of sugar refineries;
- o Control of the duration of the refining season;
- o Quality training for the cadres and workers;
- o Small-scale mechanization; and
- o Constant reinforcement of complementary research.

Short-term priorities can be listed as:

- o Market prices sufficient to cover production costs;
- o Access to investment and production credits;
- o Agricultural inputs;
- o Availability of labor when needed; and
- o Viability of the subjects offered by extension.

Long-term priorities can be enumerated as:

- o Market prices;
- o Confidence in continued property rights;
- o Access to markets and information on markets; and
- o Viability of the subjects offered by extension.

It would be necessary to recruit additional personnel to achieve the short- and long-term results.

## 9. Tobacco

The cultivation of tobacco currently covers nearly 220 ha in Mali. It is essentially covered by the High Valley Operation. The average yields during the last three years were 705, 1,812 and 1,300 kg/ha, respectively. It is cultivated in the Sudanian and Sudano-Sahelian zones. The constraints which have affected its production were:

- o Climate was harsher in 1980 than in 1981 and even less so in 1982. The same was true for the volume and distribution of precipitation;
- o Labor;
- o Long-term credit;
- o Prices;
- o Import policy;
- o Land tenure; and
- o Agricultural labor.

Possible short-term yields could be 1,700 - 2,000 kg/ha, with an additional area of 300 - 500 ha. Long-term yields could be 2,500 kg/ha.

Short-term action to be taken would include:

- o Research on production costs;
- o Varietal research, introduction;
- o Research on soil types;
- o Installation of motorized pumps;
- o Increase in prices paid to producers; and
- o Securing of water supply.

Long-term action to be taken would encompass:

- o Continuation of above-mentioned actions; and
- o Improvement of harvest and drying conditions.

Short-term priorities would include:

- o Market prices sufficient to cover the production costs;
- o Access to equipment and production credit;
- o Agricultural inputs; and
- o Confidence in land tenure over a long period.

Long-term priorities would include:

- o Market prices;
- o Access to credit;
- o Agricultural inputs; and
- o Property rights.

It is not necessary to recruit new personnel to achieve these results.

B. Survey Results on Constraints to Each Livestock Sector

The study revealed the principal constraints which are summarized as follows for each major sector:

1. Production of meat, milk and hides

In the current system of animal husbandry in Mali, it is difficult to separate production of these three products (meat, milk and hides), since livestock herding is not specialized.

The constraints which have been identified are as follows:

- o Constraints associated with physical factors: Insufficient rainfall and the practice of brush fires;
- o Constraints associated with nutritional factors: The pastures are deteriorating, the availability of other forage is low (agro-industrial by-products are becoming rare because they are used for purposes other than feeding livestock). The practice of forage cultivation is not sufficiently extended nor mastered;
- o Constraints associated with watering factors: Losses resulting from the drying up of natural watering places. The well drilling programs have not been completed, and the problems of pumping water have not been resolved;

- o Constraints associated with animal health: Serious constraints, preventive and curative difficulties;
- o Constraints linked to socio-traditional factors: Major constraints have been identified for the socio-traditional factors of herd management for watering. The technical capacity of the breeders only constitutes a constraint in the Sudanian-Guinean zone; and
- o Constraints associated with economic factors: Serious constraints have been identified with respect to the prices of animal products and marketing.

The current level of production has been judged too low. It can attain an average level in the short-term if advanced technology available in the country were utilized by the producers; in the long-term, the level could become high if the constraints are eliminated or reduced, and assuming that the results can be utilized by all of the producers.

## 2. Egg production

The constraints identified are associated with:

- o Nutritional factors: Particularly the availability of poultry feed, which is essentially made of grain;
- o Animal health: Preventive and curative problems are major;
- o Socio-traditional factors: The constraints on the technical capacity of the herders are serious; and
- o Economic factors (marketing).

## C. Survey Results of Agro-Forestry Constraints

Agro-forestry is an old activity in Mali and it is difficult to give estimates with respect to the growth of pastures and the effects of soil enrichment. Nevertheless, it can be stated that the major constraints in the production of firewood are associated with the physical factors of the environment, in particular rainfall, and the acquisition of land. The farmers do not trust their property rights since the land belongs to the State which can use it at any time.

## D. Survey Results on the Constraints to Fishing (Continental Fishing)

With respect to fisheries, the fragmented results do not permit the classification of constraints according to boat types; however, the constraints associated with fishing gear can be discussed. The most significant of these are:

- o The hydroclimate;
- o Credit; and

- o Infrastructure designed for aquacultural needs.

E. Comments on the Survey Results on Constraints

The principal constraints which affect the production of crops can be summarized as follows:

- o Climatic constraints: The irregularity and low volume of rainfall does not permit the normal rising of the rivers for irrigated crops;
- o Pedological constraints: Many of the soils have been depleted and are unsuitable for irrigated cultivation;
- o Technical constraints: Included here are varieties, ineffective weed control, frequency of diseases, particularly for rice and most recently for maize, lack of adequate planning in the rice fields, weakened condition of the animals at the beginning of the season, defective networks and facilities, lack of equipment, extensive losses both before and after the harvest and themes which are often incorrectly or insufficiently applied, and, in certain cases lack of qualified personnel; and
- o Economic constraints: Inadequate agricultural resources, rampant price increases for agricultural inputs, and low prices received by the producers which are insufficient to cover production costs.

Given these handicaps, all appropriate measures must be taken to lift these constraints or lessen their effect through coherent intervention related to the entire range of actions to be taken.

Generally speaking, the dryland crops have suffered during the last three seasons from insufficient rainfall and the general absence of river risings. The depletion of soils, the weeds, and the economic factors (prices, credit, marketing, subsidies) have been the principal constraints affecting crop production which require constant support from extension services to the farmers.

In the livestock field, it has been difficult to formulate responses in the surveys conducted to evaluate the level of production. The yields are difficult to evaluate for an extensive breeder and often take on the characteristics of "gathering."



The responses given have been evaluated in relation to the short- and long-term needs of national consumption of meat, milk, eggs, and hides.

The questionnaires for the constraint surveys, particularly in the area of agro-forestry, do not correspond to the realities in Mali. With respect to firewood, it would have been more profitable to evaluate the short-term needs and the long-term potentials of natural formations and industrial plantations. This is a high national priority to meet the populations' needs.

## VII. CONCLUSIONS AND GENERAL RECOMMENDATIONS

The Republic of Mali is a country in which rural development is the centerpiece of its economic and social development. Approximately 83 percent of the population lives in rural areas and is engaged in rural activities. The objectives assigned to this sector of the economy by the five-year plan for economic and social development are: food self-sufficiency, the supply of raw materials to the local industries, and the development of exports in the widest possible variety of forms. To achieve these objectives, the country has institutional structures responsible for the design and implementation of government policy in the area of rural development. These institutions are the Ministries of Agriculture and Rural Development with their various services.

Agricultural research, initially the responsibility of the Institute of Rural Economics (IER) is currently conducted within the IER at the level of the Division of Agronomic Research and within the new National Institute for Animal Husbandry, Forestry and Hydrobiological Research (INRZFH). In spite of these extremely important efforts and some noteworthy accomplishments, agricultural research in Mali has some serious problems with respect to organization, programming and, above all, financial, material, and human resources. The success of development efforts asked of the rural population, in particular with respect to food self-sufficiency and the supply of raw agricultural materials to local industries, depends essentially on the dynamism of research and its capacity to generate technology adapted to the rural environment and accepted by the rural population.

The Government of Mali has made some important sacrifices for agronomic research, drawing from its own funds, and also from international aid received for this research. But in order for agricultural research to be able to play its role fully, a stable organization, assured of continuity, is necessary. Its evolution must be dictated solely by considerations linked to agricultural evolution and progress.

Agricultural research is insufficiently equipped with the human, material and financial means to effectively fulfill the role assigned to it. These programs until now do not seem to correspond to the realities of rural life because they are all designed to be carried out under the conditions existing in the stations. Extension efforts are not coordinated as the extension services in the field lack the support of research efforts to resolve certain technical problems. They are also not informed of scientific progress, given their isolation from the urban centers. The agents have need of continuous information. Training lacks permanent national cadres. Inter-institutional relations (research-extension-training) are unapparent or non-functional.

The survey questionnaires probably had a weakness: despite the mass of information they provided, they would have been of better quality if test surveys had been conducted on the entire range of activities under study.

Thus, the following actions are recommended:

- o Search for overall financing sufficient to undertake and correctly carry out the agricultural research programs;
- o Replacement of the current scheduling system, which is formulated depending on foreign financing and results in the abandonment of programs upon the termination of financing, by agricultural research program;
- o In the interests of a better utilization of the network of stations, research support bases and permanent experimentation bases, the existing stations should operate regionally and in a versatile fashion with effective integration of activities at the regional and local level using multidisciplinary research teams;
- o With the progressive creation of multidisciplinary and versatile regional stations, the current organization based on a given product should evolve toward an organization based on a scientific discipline;
- o Given the dispersal of research activities on technology in the various stations, coordination at this level in the area of food technology, post-harvest technology, storage, etc., areas which have so far been studied little in Mali, is recommended;
- o Revaluation of researcher status (research bonuses, various forms of compensation, research status providing incentives);
- o In the interests of retaining qualified and motivated researchers, it is strongly recommended that researchers be given a status that provides incentives. Indeed, the only equitable and practical solution for recruiting and retaining researchers with good potential, aside from the attraction of an interesting position and national importance, is to offer them: (a) adequate remuneration and (b) a system of promotion which provides motivation; and
- o In the interests of reducing the isolation of the researchers in scientific matters, it is recommended that the scientific information system be improved for researchers working in stations which lack scientific documentation and which are isolated from scientific progress.

Other research priorities are listed as follows:

- o Improvement in the scientific information system for extension activities;
- o Creation of complementary research and continuing training components within the Rural Development Operations and the extension services;

- o Rationalization of a national extension policy and reinforcement over the entire country;
- o Improvement in the level of human resources in the quantity and quality of the training institutions;
- o Lift the constraints involving physical factors in order to promote development;
- o Make credit accessible to the rural populations in order to raise their standard of living through agricultural development;
- o Harmonize the inter-institutional relations between research, training and extension; and
- o Sensitize the sources of foreign financing to the acute problems of the agricultural system.

ANNEX 1

Programs and Projects

## I. CROP IMPROVEMENT

The principal objective will be to create high performance crops which are able to withstand intensive agriculture (plowing-fertilization-chemical weed treatment), are disease and insect resistant, and produce high quality harvests.

### A. Improvement of Millet

#### 1. Justification

Along with sorghum, this is the food staple of the population throughout the country. The cultivation of millet predominates north of the 700 mm isohyet.

Hardier than sorghum, it is less affected by drought. Therefore, its cultivation is essential in the sub-Sahel and Sahel zones.

#### 2. Brief description

The program involves the study of local traditional and introduced millet, as well as:

- o Improvement of local millets through the creation of synthetic varieties;
- o Creation of dwarf varieties of millet through genetic transfers;
- o Research on deep root systems;
- o Research on high-yielding hybrids;
- o Research on technology types and applications;
- o Research on crop tolerance to mildew.
- o The expected duration of the project is five years.

#### 3. Resources

- o Four engineers, five technicians and seven monitors are required;
- o Equipment needs include the construction of offices, sheds, laboratories and housing and the purchase of a vehicle, laboratory equipment and agro-physiological materials.
- o The estimated budget totals FM 500,000,000.

#### 4. Expected results

- o Development of varieties adapted to the ecology in which millet is grown, resistant to sclerospora, and able to withstand heavy rain and sun;
- o Improvement of seed/chaff ratio by reducing stalk height;
- o Increased crop production.

### B. Improvement of Sorghum

#### 1. Justification

Sorghum is the principal crop of Mali and, together with millet is an important staple of the population. Its low yields and weak resistance to drought have a serious impact on the farmers' goal of food self-sufficiency.

#### 2. Brief description

Research will focus on the selection of several types of varieties, including:

- o Stable introduced varieties of local origin;
- o Short-, medium-, and long-cycled varieties;
- o Sterile male varieties to make hybrids.
- o The estimated duration of the project is five years.

#### 3. Resources

- o Three engineers, five technicians, and seven monitors are needed;
- o Equipment needs include the construction of offices, laboratories, a greenhouse and housing and the purchase of a vehicle.
- o The estimated budget is FM 425,000,000.

#### 4. Expected results

- o Development of sorghum varieties resistant to drought;
- o Introduction of early, medium and late sorghum;
- o Development of productive sorghum with vitreous grain and an improved grain/chaff ratio, satisfaction of consumer taste.

## C. Improvement of Corn

### 1. Justification

A plant with great production potential, corn is the rainfed crop which derives the most value from the factors of production, particularly fertilizer. An extension of this crop into more arid zones could contribute substantially to attaining food self-sufficiency.

However, poor yields, attacks by parasites during cultivation and after harvest, and intensive cultivation techniques are the principal characteristics encountered in this crop. The same is true of its water requirements.

### 2. Brief description

- o Study of local or introduced varieties;
- o Selection of local material;
- o Creation of hybrids and composites;
- o Increasing ability to withstand heavy rain and sun;
- o The estimated duration of the project is five years.

### 3. Resources

- o Three engineers, five technicians and seven monitors are required;
- o Equipment needs include the purchase of a vehicle, the construction of offices, a laboratory and housing, as well as office material;
- o The estimated budget totals FM 375,000,000.

### 4. Expected results

- o Development of early varieties which are resistant to blight and able to withstand heavy rain and sun;
- o Increase in the productivity of the local material;
- o Enlargement of the genetic base of the local material;
- o Creation of food surpluses.



## D. Improvement of Rice

### 1. Justification

Rice cultivation is an activity which is essential to Mali. Four types of rice cultivation are practiced: swamp, flood irrigation, floating and rainfed. For several years the country has followed a set rice development policy.

Decreases in yield due to competition from wild rice, attacks from birds and the irregularity in rainfall are factors which affect the production of rice.

### 2. Brief description

- o Collection and introduction of various varieties of rice;
- o Perfection of a range of varieties from high and stable yield to high quality grain;
- o Efforts to obtain highly adaptable varieties, which can grow under changing environmental conditions;
- o Efforts to obtain quick-ripening varieties tolerant to pyriculariosis, permitting double cropping.
- o The estimated duration of the project is five years.

### 3. Resources

- o Five engineers, seven technicians and ten monitors are required;
- o Equipment needs include the redevelopment of experimental plots, tractor, levelling equipment, material for protection against birds, vehicles, offices, warehouses and housing.
- o The estimated budget has not yet been stipulated.

### 4. Expected results

- o Development of varieties adapted to swamp rice cultivation;
- o Development of short and very short cycle varieties of rice permitting double cropping and adapted to the off-season;
- o Development of quick-ripening varieties with very high productivity;
- o Evaluation of varieties adapted to floating rice cultivation conditions;

- o Determination of varieties of rainfed rice which are best adapted to the southern region of the country and which are resistant to drought, heavy rain and sun and pyriculariosis.

#### E. Improvement of Cowpeas

##### 1. Justification

A crop which has become more common to the diets of a number of populations, the cowpea offers, in addition to its great nutritive value, great adaptability to different climatic conditions and resistance to drought.

However, its essential limitation is its vulnerability to insect attack.

##### 2. Brief description

- o Improvement of local and introduced material;
- o Adaptation of varieties to different climates;
- o The project duration has not yet been determined.

##### 3. Resources

- o Two engineers, three technicians and five monitors are required;
- o Equipment needs include the construction of an office, a laboratory and housing, the purchase of equipment, a vehicle and materials for grain treatment;
- o The estimated budget totals FM 250,000,000.

##### 4. Expected results

- o Widespread use of cowpea varieties by the farmers.

#### F. Improvement of Groundnuts

##### 1. Justification

Importance of the groundnut to the Malian economy and as a source of food for farmers. There has been a decrease in the production of groundnuts in the past few years.

##### 2. Brief description

- o Introduction and evaluation of new varieties;

- o Research into varieties which can produce high yields after shelling, possess a high oil content and a high production potential;
- o Search for varieties which are resistant to Rosetta virus disease;
- o The estimated duration of the project is three years.

### 3. Resources

- o One engineer, three work engineers and ten monitors are required;
- o Equipment needs include one shed, one warehouse, one four-wheel drive vehicle, housing, a harrow seeder, a weighbridge and scales;
- o The estimated budget totals FM 150,000,000.

### 4. Expected results

- o Development of varieties adapted to the different climatic conditions and more productive than those currently in use; and
- o Perfection of pure high-value seeds for developers.

## G. Improvement of Wheat

### 1. Justification

Wheat, which is cultivated in the off-season, is being introduced and extended in the northern zone. Its planting deadline poses a varietal problem which urgently needs to be resolved.

### 2. Brief description

- o Introduction and adaptation;
- o Creation of photoperiodic and less water intensive varieties;
- o The estimated duration of the project is five years.

### 3. Resources

- o Two engineers, five technicians and seven monitors are required;
- o Equipment needs include the construction of an office, laboratories and housing. Also necessary are irrigation pumps, levelling equipment, and the purchase of four-wheel drive vehicles;

- o The estimated budget totals FM 400,000,000.

4. Expected results

- o Development of varieties which can replace those currently in widespread use.

H. Improvement of the Cotton Plant

1. Justification

The cotton plant is a textile and food crop which is also an important component of Mali's agricultural exports.

Unfortunately, the varieties currently in widespread use have certain defects: poor germinating ability, difficult development, and insufficient yields of fiber during periods of rain deficit.

The completion of the oil mill at Koutiala justifies the improvement of the glandless program, as well as efforts to obtain maximum oil contents in the traditional varieties.

The extension of the activities of the Niger Office is partly justified by the development of long silk cotton cultivation.

2. Brief description

- o Introduction of foreign varieties;
- o Improvement in the standing power of varieties;
- o Improvement in precocity;
- o Improvement in fiber yields and technological characteristics;
- o Efforts to obtain glandless varieties;
- o The estimated project duration is five years.

3. Resources

- o Five engineers, seven technicians and ten monitors are required;
- o Investment needs are as follows: redevelopment of the cotton-gin warehouse; construction of a laboratory, offices and warehouses at the N'Tarla station; purchase of gins, presses, weighbridges, scales and vehicles; creation of a station in the irrigated zone of the Niger Office (development of 200 ha, installation of laboratory service buildings, offices, work- and general-service shops), purchase of tractors and equipment for electrical power generators and vehicles for this new station.

- o The estimated budget totals FM 650,000,000.

4. Expected results

- o Development of dry crop varieties which are highly productive and combine good length of fiber and high yield after processing, with a satisfactory resilience for glandless varieties and with high yields in oil; and
- o Perfection of long silk varieties of cotton plants for the irrigated zone of the Niger Office.

I. Improvement of Fruit Tree Cultivation

1. Justification

The cultivation of mangos and citrus fruit could have substantial impact on both the domestic and export markets.

However, mango production continues to be limited by the need to stagger harvests in order to extend output. This problem is currently being researched.

On the other hand, the essential problem for citrus trees is their vulnerability to parasites.

Other fruit trees including the avocado, pineapple, and banana, also have a certain market potential.

2. Brief description

- o Introduction of various foreign varieties of fruit trees;
- o Efforts to obtain very quick-ripening varieties of mango trees;
- o Efforts to obtain late and very late mango trees which are parasite-resistant;
- o Developed use of polyembryony.

3. Resources

- o Five engineers, ten technicians and eight monitors are required;
- o Investment needs include the creation of a new station (the Bamako station is in the city limits), the development of irrigation and farming on the PAR, the construction of offices, laboratories, housing, acquisition of tractors, vehicles, scales and weighbridges;
- o The estimated budget totals FM 1,350,000.

4. Expected results

- o Development of fruit tree varieties well adapted to different climatic zones.

J. Improvement of Vegetable Crops

1. Justification

Diversification of the population's food sources is desirable and goes hand-in-hand with improvements in the standard of living.

The export of vegetable products could help spur faster economic growth.

2. Brief description

- o Perfection of high-yield, bacteria-resistant and adapted varieties;
- o The estimated duration of the project is five years.

3. Resources

- o Two engineers, three technicians and five monitors are required;
- o Equipment needs call for the development of test plots, construction of a shed, and the purchase of a vehicle, insecticide treatment material and weighing equipment;
- o The estimated budget totals FM 170,000,000.

4. Expected results

- o Development of vegetable varieties which produce high yields and are resistant to bacterial diseases.

K. Improvement of the Tea Plant

1. Justification

This project involves an experiment in agricultural product diversification. Domestic and export market outlets for the results are assured.

2. Brief description

- o Introduction of new varieties - planting of shoots;
- o Selection and varietal creation;
- o The estimated duration of the project is five years.

3. Resources

- o Two engineers, three technicians and five monitors are required;
- o Also necessary is the construction of offices, laboratories and housing, as well as the purchase of a tractor, equipment, and a vehicle;
- o The estimated budget totals FM 375,000,000.

4. Expected results

- o Selection of varieties which are beneficial from the standpoint of production and technological qualities.

L. Improvement of Tobacco

1. Justification

- o Diversification of production during the off-season;
- o The perfection of varieties and appropriate techniques in order to meet the requirements of domestic and export markets.

2. Brief description

- o Introduction and adaptation of foreign species;
- o Efforts to obtain disease-resistant varieties;
- o Improvement in the quality of the tobacco leaf.

3. Resources

- o Three engineers, five technicians and six monitors are required;
- o Other requirements include the creation of a station, the construction of offices, sheds, housing and laboratories, the development of experimental plots and the purchase of tractors and vehicles;
- o The estimated budget totals FM 750,000,000.

4. Expected results

- o Development of varieties responding to consumer taste.

## II. AGRONOMY

The current demographic evolution no longer allows traditional agricultural systems to be maintained. In many regions, the soil is being depleted and a disequilibrium is developing in the fertilizing elements.

Quite often, harvest remains are exported or burned. This has resulted in a decline in soil fertility and has limited the intensification of agriculture.

A program of accelerated intensification of agriculture is therefore indispensable from both the economic and social points of view.

### A. Knowledge of the Environment and Morphopedological Studies

#### 1. Justification

A thorough understanding of the natural environment is vital to any development project.

The determination of soil fitness for cultivation based on edaphic constraints is necessary in order to quickly determine where to target extension efforts.

#### 2. Brief description

- o Soil analysis: description of the natural environment and analysis of the processes of morphogenesis-pedogenesis;
- o Preparation of morphopedological and development maps with agricultural orientations, delineation of protective and conservation measures.
- o Duration: The annual pedologic work unit is 14,000 - 15,000 km<sup>2</sup>.

#### 3. Resources

- o Three engineers and five technicians are required;
- o The construction of a cartography laboratory, purchase of four-wheel drive vehicles, pedologic prospecting equipment, and soil laboratory equipment are also required.
- o The estimated budget totals FM 250,000,000.



## B. Fertilization - Improvement in Soil Utilization

### 1. Justification

Numerous factors influence crop productivity, including the availability of water and rainfall patterns. Thus, it is vital that the problems inherent to each crop be addressed comprehensively and independently, particularly when the soil is of poor quality.

### 2. Brief description

- o Research on fertilizers which can compensate for poor soil;
- o Research on more efficient methods of recycling the mineral elements found in the harvest remains;
- o Practical means of using natural phosphates;
- o Reformulation of mineral composts;
- o Chemical weed elimination;
- o Irrigation.
- o The estimated duration of the project is five years.

### 3. Resources

- o Six engineers, seven technicians and ten monitors are required;
- o Other needs include improvement of offices and laboratories, the purchase of laboratory equipment (ionanalyzer, technicom, photometer, precision scales), along with tractors and other equipment.
- o The estimated cost of the project is FM 890,000,000.

### 4. Expected results

- o Determination of the technical factors of production;
- o Specification of fertilizer formulas by principal ecological zones;
- o Fertilizer conservation;
- o Influence of mineral elements and organic material on soil fertility and plant nutrition;
- o Appropriate utilization of harvest remains.

## C. Study of Soil-Water-Plant Relationships

### 1. Justification

The introduction of technical studies adapted to local conditions as reported by soil scientists cannot be accomplished without a more precise knowledge of the soil-water-plant relationships. Such knowledge permits a better definition of the agricultural fitness of the environment under study.

### 2. Brief description

This new high priority program should address:

- o Agro-pedoclimatic zoning of the country;
- o Perfection of methods for determining amounts of evaporation and crop water needs;
- o Hydrous and hydro-dynamic characterization of ground water;
- o Research to improve the hydrous status of rainfed crops;
- o Research to increase knowledge on the evaluation of resistance to drought.
- o The estimated project duration is four years.

### 3. Resources

- o Three engineers and two technicians are required;
- o Construction of offices, sheds and laboratories is needed as well as the purchase of a micro-computer, agrometeorological micro-computer supplies, agricultural equipment (animal tractor and small motor-driven), four-wheel drive vehicles.
- o The approximate cost of the project is FM 950,000,000.

### 4. Expected results

The results obtained should allow a very rapid practical application of the following to development problems: creation of a network of agricultural warnings; agricultural input planning, forecasting harvests based on climatological, mainly rainfall conditions.

#### D. Study of Cultivation Techniques

##### 1. Justification

The continuous increase in the price of mineral fertilizers has led to stepped-up research on how to use them more efficiently and profitably. Similarly, soil-working techniques are an extremely important factor in water conservation (drought control).

##### 2. Brief description

- o Evaluate cultivation techniques in order to improve the hydrous condition of soils and the rate of fertilizer utilization and growth in the level of organic matter in soils under different pedoclimatic conditions;
- o Study plowing methods;
- o Define methods for seedbed preparation;
- o Study of the dates and methods for spreading fertilizer.
- o The estimated project duration is five years.

##### 3. Resources

- o Three engineers, five technicians and seven monitors are required;
- o Purchase of a tractor, equipment, animal-traction equipment, a fertilizer spreader, and a syrogrinder.
- o The estimated project cost is FM 175,000,000.

##### 4. Expected results

Optimal use of water reserves; erosion control; improvement of the physical properties of the soil; improvement of weed elimination techniques; study of sowing dates and density; study of types of mechanization for working the soil; and specification of cultivation systems for each ecological zone.

### III. CROP PROTECTION

In Mali, the invasion of the rice fields by weeds, stem borers and birds are problems of the greatest concern.

Cotton cannot be grown without phytosanitary protection. Similarly, the problem of "sticky cotton", which complicates processing, must be solved.

Viral diseases are a hindrance to the production of fruits and vegetables. In the Kayes zone, for example, cantharides make the production of millet impossible. However, even though the damage caused by insects and disease is significant, the farmers cannot always afford chemical treatment methods.

As a result, the project's most important objectives should be research on crop varieties which are resistant to these diseases and on efficient, affordable phytosanitary products.

#### A. Food and Oleaginous Crop Protection

##### 1. Justification

The reason for this project is the extent of damage to food and oleaginous crops.

##### 2. Brief description

- o Inventory and identification of parasites and cryptogamic diseases;
- o Evaluation of losses and damages;
- o Bioecological and livestock studies;
- o Experiments on pesticides, herbicides and fungicides;
- o Experiments on appropriate agricultural techniques;
- o Selection of resistant varieties.
- o The estimated project duration is five years.

##### 3. Resources

Requirements include vehicles and construction material for housing, the cost of which is estimated to be 650 million francs.

4. Expected results

The expected results are:

- o An assessment of the various insects and parasites attacking food and oleaginous crops;
- o Determination of the extent of damage;
- o Determination of efficient pesticide products;
- o Development of resistant varieties.

B. Phytosanitary Protection of the Cotton Plant

1. Justification

Efficient phytosanitary protection is the sine qua non for cotton cultivation.

Constant experimentation on new products and equipment is required to perfect protective methods.

2. Brief description

This project will include:

- o An inventory of predators and diseases;
- o Study of the dynamics of insect populations;
- o Study of the procedures for seed disinfection;
- o Study of insecticide formulas;
- o Study of the frequency of application;
- o Animal husbandry;
- o The estimated project duration is five years.

3. Resources

- o Three engineers, six technicians and seven monitors are required;
- o Other needs include a vehicle, laboratory equipment, construction of an insectarium-greenhouse, treatment and animal husbandry material;
- o The estimated project cost is FM 300,000,000.

#### 4. Expected results

- o Knowledge of the main pests and their biology;
- o Evaluation of the extent of damage they cause;
- o Development of resistant varieties;
- o Selection of pesticides.

### C. Protection of Fruit and Vegetable Crops

#### 1. Justification

Disease and parasites are significant causes of productivity declines in orchards and gardens, and can go so far as to prevent cultivation of certain crops in the heavily infested zones.

#### 2. Brief description

This project includes:

- o An inventory of plant and animal parasites;
- o Study of the dynamics of populations and biological cycles of parasites;
- o Study of effective methods of parasite control;
- o Study of varietal resistance;
- o The estimated project duration is five years.

#### 3. Resources

- o Two engineers, five technicians and five monitors are required;
- o A vehicle, laboratory equipment for treatment and animal husbandry, and an insectarium are also needed;
- o The estimated project cost is FM 200,000,000.

#### 4. Expected results

- o Knowledge of the principal parasites;
- o Determination of the resistant varieties;
- o Determination of effective pesticide products.

#### IV. TECHNOLOGY

The general objective of this project is to define qualitative selection criteria to assist breeders in creating varieties appropriate for planned use and consumer taste, as well as:

- o Perfection of appropriate methods of analysis; and
- o Development of industrial products better adapted to demand.

##### A. Grain Technology

###### 1. Justification

Indispensable support for the varietal improvement of grains.

###### 2. Brief description

This project will include:

- o Hulling of grain and protein seeds;
- o Milling programs;
- o Conservation of flour;
- o Flour processing.
- o The estimated project duration is five years.

###### 3. Resources

- o Two engineers and three technicians are needed;
- o A milling laboratory, conservation and processing material, offices, housing, and a vehicle are also needed.
- o The estimated cost of the project is FM 100,000,000.

###### 4. Expected results

The expected results are:

- o Valuable assistance to grain breeders; and
- o Improvement of grain products.

B. Textile Fiber Technology

1. Justification

This project is required to determine and choose the varieties to propose for development.

2. Brief description

Technological analyses are involved. The project shall last five years.

3. Resources

- o One engineer, five technicians and seven laboratory personnel are required;
- o Rearrangement of existing laboratory, purchase of laboratory equipment.
- o The approximate project cost is estimated to be FM 75,000,000.

4. Expected results

Valuable assistance to breeders in choosing promising varieties.

C. Fruit and Vegetable Technology

1. Justification

Setting objectives for varietal research.

2. Brief description

This project includes:

- o Analysis of fruits and vegetables;
- o Technology for drying and processing into juice, nectar, preserves, jellies;
- o Study of techniques for preservation.

3. Resources

- o Two technological engineers, four technicians and five laboratory personnel;
- o Creation of a pilot plant; preservation, processing and drying equipment, one vehicle, housing and a refrigeration chamber.



- o The estimated project cost is FM 150,000,000.

4. Expected results

Valuable assistance to breeders in choosing promising varieties.

D. Tea Cultivation Technology

1. Justification

This project is deemed indispensable for the development of fine tea products.

2. Brief description

- o Processing, tea quality control;
- o Analyses;
- o The estimated project duration is five years.

3. Resources

- o One engineer, two technicians and four laboratory personnel are required;
- o Processing and quality control equipment, one dryer, analytical equipment, vehicle, housing, rearrangement of laboratory;
- o The approximate cost of the project will be FM 175,000,000.

4. Expected results

Assistance in the definition of selection criteria.

E. Tobacco Cultivation Technology

1. Justification

Indispensable for the development of fine tobacco products.

2. Brief description

- o Drying;
- o Study of fermentation and packaging;
- o Taste analyses;
- o The estimated project duration is five years.

3. Resources

- o One engineer, two technicians and four laboratory personnel are required;
- o Construction of a dryer and a tobacco analysis laboratory, analytical equipment and a transport vehicle are also needed;
- o The estimated project cost is FM 400,000,000.

4. Expected results

Selection support for the choice of varieties.

## V. PROGRAMS ASSOCIATED WITH RESEARCH

### A. Research Associated with Rural Development Operations

#### 1. Justification

Adaptation of station findings to local agricultural conditions is indispensable if the techniques are to be perfected.

#### 2. Brief description

Varietal and crop tests. Monitoring soil fertility and the formation of organic material. The project is expected to last five years.

#### 3. Resources

- o Eight engineers, ten technicians and 20 monitors are required;
- o Other needs include vehicles and tractors, as well as the reinforcement of existing research support bases (PAR) and permanent experimentation bases (PEP) by the construction and equipment of offices, laboratories and housing as well as agricultural equipment;
- o Creation of new PAR's and PEP's;
- o The estimated project cost is FM 800,000,000.

#### 4. Expected results

- o Experiments directly addressing problems faced by farmers;
- o Optimization of farm production using animal-traction cultivation methods;
- o Exploration of possibilities presented by the introduction of mechanized cultivation.

### B. Control and Certification of Seeds

#### 1. Justification

An organized seed production system cannot be adopted without the use of product quality control at all stages of production.

#### 2. Brief description

- o Control of foundation seed origin;
- o Periodic inspection of seed fields;

- o Selection and control of samples from harvest to storage;
- o Germination tests on seeds;
- o The estimated project duration is five years.

3. Resources

- o Three engineers and seven technicians are required;
- o Also needed are testing and grain-conservation equipment, sterilizers, germinators, vehicles and branch offices;
- o The estimated project cost is FM 500,000.

4. Expected results

Guaranteed seed quality.

E. Creation of a Phytogenetic Resource Center

1. Justification

The need to conserve phytogenetic resources for selection support.

2. Brief description

- o Organization and execution of phytogenetic prospecting;
- o Evaluation and conservation of prospected material;
- o Establishment of gene and data banks;
- o Drafting and disseminating documents on phytogenetic resources;
- o The estimated project duration is five years.

3. Resources

- o Four engineers, seven technicians and 12 monitors are required;
- o An office-laboratory complex, shed, warehouse, housing, refrigeration chamber, micro-computer, generator sets, vehicles and office and laboratory equipment are also needed;
- o The estimated cost of the project is FM 580,000,000.

4. Expected results

Collection, conservation and evaluation of all local and introduced varieties.

## VI. RESEARCH PROGRAM ON FARMING SYSTEMS

### A. General Objectives

Quite often, technology developed in the research station is not appropriate for prevailing agro-climatic conditions nor the farmer's resource limitations. In such cases, the result is that the recommended practices are limited in their effectiveness in that they do not resolve the critical problems of production at the farm level.

The development of technologies which take into account micro-climates, farmer resources and limitations, and production objectives could be achieved by emphasizing research directed toward resolving problems; improving contact between farmers, researchers and developers; analyzing constraints and resources; and integrating the farmer's empirical knowledge into the research programs.

### B. Research Project on Farming Systems

#### 1. Justification

Reorientation of agricultural research towards farming systems is essential if the agricultural research is to be made more pertinent.

Identifying production constraints and the integration of such information into the design and treatment of technology will allow better adaptation of thematic research to farmer conditions and resources, particularly those in the Sahel zones, where the ecological equilibrium is fragile.

#### 2. Brief description

- o Preparation of general guidelines to define appropriate and agronomic zones and to recommend certain areas;
- o Conduct systematic analyses of constraints and resources;
- o Designing of projects based on analysis of constraints, followed by experimentation in the farmers' fields;
- o Consolidate and establish contacts between farmers, researchers and extension agents;
- o The estimated project duration is seven years.

#### 3. Resources

- o Eight researchers, 17 technicians and 20 support agents are necessary;

- o Vehicles research equipment, offices, housing, extension of existing offices, equipment for offices and housing are also required;
- o The estimated cost of the project is FM 1,600,000,000.

4. Expected results

The farmers will enjoy increased productivity, higher income, and better general well being in the regions involved in the project.

## VII. ZOOTECHNICAL RESEARCH

### A. USAID Sectorial Project/Research on the Improvement of Animal Production

#### 1. Justification and objectives

Research results in the stations have had very little impact on the standard of living of small scale farmers. The objective of this contract is to furnish assistance to the government of the Republic of Mali through the INZRFH in the area of integration of small-farm agricultural and animal production systems. Emphasis will be placed on:

##### o The Research Approach to Farming Systems

The objectives include the creation of training programs for the research unit staff and the selection of candidates for "participant training";

##### o Rural Feed Program: The objectives include:

- The identification of basic technical and socio-economic constraints on the expansion of the Rural Feed Program of the ECIBEV; and
- The design and establishment of a program in the ECIBEV rural feed zone where technical and socio-economic constraints have been identified.

##### o Study of Small Ruminant Production

One of the objectives will be the identification of the technical and socio-economic constraints to small ruminant productions in the semi-arid zone of Mali.

#### 2. Brief description

Given the objectives cited above, the contracting party ILCA will assist the INZRFH in the planning and establishment of a farming systems research unit and will work closely with this unit in performing the following tasks:

- o Assist in the design and selection of participant training programs for studies at the university level on a short-term basis, assuring that these participants will take courses allowing them to fulfill their role in the farming systems research unit program;
- o Conduct of an initial survey of ECIBEV rural feed zone villages in order to select the representative villages at which level it will be possible to carry out and manage the program;



- o Perform an in-depth study of the chosen villages in order to define the production systems and collect basic data;
- o Identification of the basic technical and socio-economic constraints to the expansion of the Rural Feed Program in the representative villages. In light of this in-depth study, possible constraints on animal nutrition, animal health, terrain utilization systems, labor availability and the formation of farmer associations will be defined as well as other types of constraints which could appear during the course of these studies;
- o Select the appropriate technology for field tests, with the aim of lifting the basic constraints in these villages (previous work by the ILCA and other organizations will be drawn upon to the maximum extent possible);
- o Design and implementation of a farming systems research program in the representative villages in order to identify/test the appropriate technologies deemed adequate for the farm;
- o Establishment of an adequate mechanism for the transfer of technologies which proved successful during the test to other villages in the EBICEV rural feed zones;
- o Establishment and implementation of an adequate mechanism to evaluate the effects of introducing these technological innovations after they have been adopted in these farm systems;
- o The project is expected to take five years to complete.

### 3. Resources and cost

- o Ten Malian professionals, including nutritionists, two agronomists, one veterinarian, two socio-economists, and three zootechnicians are required. Also needed are two expatriates, including one fodder agronomy expert, one socio-economic expert, and one agronomy and sociology consultant;
- o Six four-wheel drive vehicles and office space is needed.
- o The projected cost is FM 2,734,000.

### 4. Expected results

- o Promotion of increased cattle and sheep feeding;
- o Improved standards of living for small farmers and women farmers;
- o Integration of agriculture and animal husbandry.

B. Identification of Zootechnical Research at the North Mopti Research and Forage Testing Station (SREF/MN-Station de recherche et d'essais fourragers Mopti-Nord)

1. Justification

- o Protection of forage potential on the delta and restoration of damaged pastures;
- o Enhancement of the forage potential zones in and outside the delta, rationalization of its use;
- o Dissemination of project results among the farmers.

2. Brief Description

This program requires:

- o Complementary development of the surrounding area;
- o The installation of complementary equipment for soil and seed preparation, crop maintenance, phytosanitary treatment, and transportation;
- o An operating budget for labor, technical training, and supplies (fuel, spare parts and maintenance).

The forage potential, consisting essentially of *Echinochla Stagina* (bourgou) and *Vossia Cuspidata*, must be protected and improved to compensate for growth in itinerate rice cultivation and the associated development of the land, as well as the increased overgrazing after years of drought.

The pastures of the inner delta of the Niger River are of exceptional importance to livestock development in Mopti.

- o The estimated duration of the project is five years.

3. Resources

- o Two agronomists, four technicians, two monitors and ten others are needed;
- o Two four-wheel drive vehicles, one canoe, miscellaneous agricultural and research equipment are also required.
- o The estimated cost is FM 202,000,000.

4. Expected results

- o Regeneration of damaged pasture lands;
- o Improved range management;

- o Improvement of the standard of living of the livestock herders in the 5th region/Mopti.

C. Study and Improvement of Pastures; Study of Tropical Forages

1. Justification

Natural pastures remain the basic source of food for most of the herds in Mali; the conditions for their improvement and rational use are one of the principal concerns of animal husbandry research.

Semi-intensive sedentary herding cannot, however, rely solely on natural pasture lands. Since the use of agro-industrial by-products is limited, it is important to resort to forage crops which can be widely cultivated.

2. Brief description

This program requires development or restoration work on the CRZ, agrostological studies and agronomic tests.

It also requires the installation of equipment for land preparation, seed and crop maintenance, phytosanitary treatments, harvest, seed and forage preservation, irrigation, fences, transportation, and laboratory analysis.

In addition, the program requires supplementary operating expenditures for labor, complementary technical staffing, operation of equipment (fuel, spare parts and maintenance), laboratory operation (bromatology, digestibility, agrostology), and the purchase of test animals.

Therefore it is necessary to develop forage crops to supply sedentary livestock with the forage units and protein they require for health and production. Thus a qualitative study of these forage plants is indispensable in order to plan the rational use of pastures, as well as to optimize the use of agro-industrial by-products.

It is noteworthy that the current five-year development plan gives priority to zootechnical research and agrostology and pasture production programs. The livestock sector is still dominated by traditional methods, which are characterized by unfavorable herding conditions which make the development of any rational production system difficult.

It is therefore important and necessary to endow the agrostology and nutrition sections of the CRZ with adequate resources in order that they might provide support to the various projects for improving pastures and developing forage crops selected in the national development plan. The estimated duration of the project is five years.

### 3. Resources

- o Human resource needs include:
  - agronomists (forage) = 2;
  - agricultural technicians = 4;
  - nutritionists = 2;
  - laboratory technicians = 10;
  - other (support) = 20.
- o Investment needs are as follows:
  - Equipment for working the soil FM 70,915;
  - Harvest equipment FM 61,982;
  - Fire fighting equipment FM 50,000;
  - Animal-Traction equipment FM 1,950;
  - Irrigation equipment FM 36,330;
  - Fences FM 150,000;
  - Vehicles FM 38,525;
  - Treatment equipment FM 2,440;
  - Laboratory equipment FM 4,700;
  - Material to clear brush wood FM 6,000;
  - Seeds FM 5,000.

The total is FM 427,845, rounded off to FM 430,000.

- o The estimated budget is:
  - Total costs: FM 730,000,000;
  - Study of pastures and forage crops: FM 430,000,000;
  - Research on forage crops: FM 300,000,000.

### 4. Expected Results

- o Improvement of pastures;
- o Improved animal nutritive levels;

- o Promotion of livestock in the Sudanian zone;
- o Improved standard of living for the livestock herders.

#### D. Research Project on the Secondary Production of Sahel Pastures in Mali

##### 1. Justification

Mali is a country with an agro-pastoral economy in which livestock represents the livelihood of a large majority of the population. Extensive livestock herding is practiced in vast regions of the Sahel, where plant growth during the wet seasons is linked to the amount of available water and mineral elements in the soil.

Livestock constituted one of the priority sectors of the five-year plan for 1974-1978: The Malian Government, conscious of the country's great livestock potential, is attempting to understand the primary production of the immense natural pastures through research programs.

Thus, one of the objectives of animal husbandry research is the search for better ecological conditions for raising livestock. This is to be achieved by affecting the milieu in order to lift the major constraints which hamper development of this very important sector (livestock accounts for approximately 21 percent of the gross domestic product).

##### 2. Brief description

Possible study projects are as follows:

###### a. In the field of sociology

- o Acceptability of the new techniques for improving, using and preserving pastures in the traditional milieu;
- o Nature of the present motivations in herd management and methods of using pastures and, if appropriate, proposals for improvement;
- o Possibilities for organizing the range management units.

###### b. In the field of animal husbandry

- o Study of reproduction and herd-structure parameters in order to better understand the dynamics of the herd;
- o Study of the relationship between herd dynamics and herd management through a review of the problems of marketing, feeding of calves, and elimination of young stock with a view to stratify production systems connecting the Sahel, the Sudan and the zones common to the Sudan and Guinea;

- o Study of the influence of all these factors on pasture use (the problem of overgrazing pastures).

c. In the field of ecology

- o Continuation of studies on regeneration of natural pastures, re-utilization of natural pastures following restoration;
- o Continuation of studies on transhumance;
- o Influence of the transhumance phenomenon on the pastures;
- o Capacity tests on the natural pastures in pursuit of optimum utilization of the transhumance pastures;
- o Continued planting of leguminous vegetation in the pastures.

d. In the field of animal nutrition

- o Continuation of studies on the digestibility of tropical herbaceous ligneous forage plants with the purpose of perfecting the feed tables under the conditions of tropical livestock herding.

e. In the economic field

- o Study of the income and other resources furnished by livestock at the herdsman's level;
- o Utilization and marketing of products;
- o Study of the economic feasibility of fertilizer use;
- o Verification of certain simulation models which will be perfected at the end of the project.

f. In the field of veterinary medicine

- o Study of the pathological problems related to the transhumance system in the Sahel; and
- o Study of nutritional deficiencies which could result from this method of animal husbandry.

3. Resources

- o Needed are several researchers: an ecologist, a physiologist, a zootechnician, a veterinarian, an economist, and a sociologist. In administration, two administrators and an aid, one secretary, one orderly, two guards and five drivers are required. Shepherds and laborers are the responsibility of the Dutch party;

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- o Equipment needs are as follows: in infrastructure, a laboratory (CNRZ - to be set up in Niono), buildings for the livestock, including animal pens, a building for experimentation on digestibility, and support by the Central Veterinary Laboratory for the acquisition of vaccines and veterinary researchers. In terms of workspace, the project requires one office for each discipline (six) (the existing PPS building and four supplemental offices to be constructed, as well as a printing and documentation room). Also needed are one large room for the administration, one conference room with library, one printing room and one warehouse. In terms of vehicles, four land-rovers and two light vehicles are needed.
- o The estimated budget is FM 803,300,000.

#### 4. Expected results

- o Development of practical formulas for pasture management in the Sahel;
- o Enhanced understanding of transhumance and its improvement as a stabilizing factor in ecological zones with complementary fodder resources;
- o Improved animal production at the breeder's level--in particular with respect to milk;
- o Reduction in calf mortality and thus an increase in livestock productivity without ecological impairment;
- o Better organization of the socio-professional structures in the livestock-meat sector;
- o Practical recommendations by the government for planning animal production development and natural resource conservation;
- o Improved efficiency of the national livestock research system.

#### E. Program for the genetic improvement of poultry

##### 1. Justification

The drought in recent years has created renewed interest among the population in small-scale animal husbandry.

The interest manifested in the subject by the last five-year plan merits continued monitoring of the increasing requests made by the rural development organizations for the acquisition of improved local stock.

## 2. Brief description

- o Selection, multiplication, and economic study of improved poultry farming production;
- o Creation of a local chicken breed by cross-breeding imported and local stock, characterized by high productivity in eggs and meat;
- o Distribution of autosexing chicks (Plymouth and Rhode Island Red) among poultry farmers;
- o Study of meat and egg production produced by different percentages of crossbreeding of the poultry;
- o Selection of the degree of crossbreeding to be extended;
- o Economic studies of improved poultry farming production;
- o Involvement at the infrastructural level;
- o The estimated duration of the project is five years.

## 3. Resources

### Genetic Material

- o Local chickens (FM 350,000)
- o Chickens of foreign stock (FM 7,365,000)
- o Total (FM 7,715,000)

### Upkeep and Feeding

- o Feeding (FM 211,700,000)
- o Veterinary care and prophylaxis (FM 4,577,000)
- o Total (FM 216,277,000)

### Restoration of Existing Infrastructure

- o Livestock pens (FM 11,000,000)
- o Incubator (FM 7,000,000)
- o Total (FM 18,000,000)

Human resource needs for this project are: one veterinarian, one zootechnician, one economist, two technicians and five general staff.

The estimated budget is FM 241,992,000.



4. Expected results

- o Promotion of poultry farming; and
- o Improved living standards for small breeders.

F. Genetic Improvement of Pigs at the CRZ.

1. Justification

Pig farming has been practiced in Mali for a long time, even though the meat of this animal is consumed by only part of the population (Christians and animists represent 40 percent of the population).

The possibilities for development of pig farming are substantial provided that a sufficiently productive and hardy stock can be propagated.

Pig farming is particularly advantageous for the rapid production of meat.

2. Brief description

- o Selection work based on the study of the meat and breeding qualities of the various products of cross-breeding; choice of the percentage of crossbreeding in order to determine characteristics for extension;
- o Securing new investments and restoring existing installations (pigsties);
- o Endowment of genetic material and reproductive animals, operating resources.
- o The estimated duration of the project is five years.

3. Resources

- o Human resource needs include one veterinarian, one zootechnician, one livestock technician and five support staff;
- o Also required are the following: genetic material, infrastructure, and animal upkeep and feeding material.
- o The estimated budget is FM 80,950,000.

4. Expected results

- o Creation and dissemination among farmers of a meat breed by crossbreeding local pigs with foreign pigs, thus combining the production performance of imported stock with the hardiness of local stock;

- o Increased productivity in pig farming;
- o Improvement in the farmers' standard of living.

G. Program for the genetic improvement of cattle through crossbreeding

1. Justification

Considering the poor level of productivity of the local bovine stock, particularly in the area of milk production, the Sotuba Zootechnical Research Center has been oriented toward a policy of genetic improvement through crossbreeding of local stock with foreign stock of a high production potential.

The crossbred cattle thus obtained should be extended around the large urban centers in order to increase milk production.

Artificial insemination is normally used for reproduction because of its many advantages. This technique has been sufficiently mastered at the Center. The creation of an artificial insemination center in Sotuba has been planned since 1977, in the hopes of extending this method of reproduction.

The "Sotuba Artificial Insemination Center" project has benefitted from French Aid and Cooperation Fund financing for the development of the irrigated perimeter of Baguineda in the amount of FM 19,600,000 (Convention No. 206/C/DDE/77/MLI/13).

The amount allocated has permitted only a partial realization of the terms of the project; to date only the basic infrastructure has been acquired.

Indeed, the CRZ program for genetic improvement, which the CRZ would like to see better adapted to the national conditions, includes, in addition to the Center activities, the creation of support bases on the outskirts of Bamako for zootechnical research, where the collection of technical data will take place. Structures oriented toward pre-extension will help ensure that the results obtained on station are applicable to the rural setting before diffusing new techniques.

The target zone is located in a 30-km belt around Bamako, particularly in the rural concessions where farmers are mainly affluent officials and businessmen. These farmers display a keen interest in animal husbandry, and are considered capable of assimilating the new development techniques for animal production quite easily. Furthermore, the agro-pastoral potential of the zone (abundant pastures, remains from grain and legume harvests, the great diversity of stocks) facilitates a better integration of the various factors of agricultural production.

The zone covers the central district of Bamako, the Baguineda and Sanankoroba districts and the community of Kati.

The improved stock used in the form of frozen seed is the Rouge des Steppes. The local genetic material covers the Zebu Maure and N'Dama.

Thus the practice of artificial insemination, the enlargement of the reproductive base of the local stock, the testing and management of the program's pilot breeders, the training and retraining of agents in the area of animal reproduction, artificial insemination, and milking techniques--in short the proper execution of the project--requires the mobilization of funds commensurate with the objectives.

## 2. Brief description

- o Improve milk production by the local stock cattle (Zebu Maures, N'Dama) by crossbreeding them (through artificial insemination) with cattle of foreign stock with high production potential;
- o Extension to farmers in the areas surrounding the large urban centers and assuring steady milk supply to the Milk Union of Bamako;
- o Establish an artificial insemination center for the production and conservation of the seed of the reproductive members of the improved race;
- o The project will be located at the Sotuba Zootechnical Research Center located 7 km from Bamako.

The actions to be taken within the framework of the program include:

- o Reinforcement of the breeding infrastructure of the CRZ (construction of two 70-stall stables, a birthing facility with 40 stalls, and a feed warehouse);
- o Finishing work on the Sotuba center for artificial insemination;
- o Installation of a liquid nitrogen production unit;
- o Equipment of the center for artificial insemination;
- o Supply of the frozen seed of Rouge des Steppes;
- o Purchase of logistics facilities;
- o Addition of local genetic material (Zebu Maure, N'Dama and heifers);
- o Purchase of technical material;
- o Acquisition of mobile milking machines for milking crossbred animals at the CRZ in Sotuba;

- o Operating expenses (feeding, animal health expenses, fuel and maintenance for the fleet of automobiles, etc.);
- o Training and refresher courses for Malian project agents;
- o Payment of bonuses and expenses to personnel.
- o The estimated duration of the project is five years.

### 3. Resources

#### a. Human resource needs

The insemination center is staffed by a veterinary doctor, three inseminators, two laborers and three shepherds assigned to the program. This staff should be supplemented by one veterinary doctor, two ISA engineers, four senior technicians, four veterinary attendants, two laborers, and five shepherds. The veterinary doctors and the engineers will undergo new training in order to adapt to technical progress while the senior technicians and veterinary attendants will receive specialized training in artificial insemination, pathology and milk techniques. They will also take refresher courses.

#### b. Plant and equipment needs

The infrastructure in place includes three stables with 70 stalls and nine pens for calves of different ages, one feed warehouse, one workshop for producing feed (this is in poor condition), one laboratory for bromatological analyses (poorly equipped, lacking products), and one artificial insemination center (unfinished, financed by FAO).

Genetic material (financed by WPF) includes:

- o 116 cows and Zebu Maure heifers;
- o 12 cows and 50 N'Dama heifers;
- o Two bulls: 1/2 Montbeliard, 1/2 Zebu Maure;
- o Two bulls: 1/2 Montbeliard, 1/2 N'Dama
- o 52 female Zebu calves and 30 Zebu male calves;
- o One N'Dama female calf and 5 Zebu Male calves.

The work to be completed includes, in addition to the activities already cited in section 3, equipping the laboratories for bromatological analyses at the artificial insemination center and increasing personnel.

- o The estimated budget is FM 794,000,000.

#### 4. Expected results

Completion of the project will permit:

- o The creation of a specialized milk herd:
- o Improved nutrition for the population will be assured. Safe supplies of milk and dairy products at lower consumer prices;
- o Increased income for the farmers guided toward a lucrative form of milk production;
- o An increase in the state's foreign currency through the reduction in imports of powdered milk, oil and butter from the WFP.

#### H. Research on Animal Breeding at the Niiono Sahel Station.

##### 1. Justification

The Sahel Station, which is located in a zone ideally suited for pasture land, has given priority to herd improvement. Until now, it has only worked with cattle. From now on, sheep and goats will also be included in the selection program.

This change was in part dictated by the drought and the increasing importance of small ruminants because of their adaptability and rapid proliferation.

##### 2. Brief description

- o Production of good breeds of Zebu Maures and Peulhs, high in milk and meat production, meeting the demands of the Niger Office Zone;
- o The highest possible production of low-cost substitute products (sheep and goats), breeding sheep with high wool and meat yields, and goats that are prolific and high milk producers;
- o Work in breeding, multiplication and management of herds in relation to the planned work on: zebu peulh and maure (meat and milk), Sahel sheep (meat) and goats (prolificity and milk);
- o Additional infrastructure endowments: service buildings and housing, fences and irrigation;
- o Additional equipment (vehicles, fertilizer) and animals.
- o The estimated duration of the project is five years.

### 3. Resources

- o Human resource needs include one veterinarian, two zootechnicians, five animal husbandry technicians, and ten support staff.

To assure proper operation of the project, it is necessary that complementary investments and equipment be brought to bear, to supplement existing material and equipment.

- o Additional infrastructure needs would include: offices, housing, stables and pens; ranch fence (12,000 ha); repair of the irrigation network (420 ha); construction of an equipped garage within the ranch; clearing of the canal serving the ranch or creation of equipped wells on the ranch; restoration of the irrigated perimeter;
- o Additional equipment needs would include: complete renewal of the automobile fleet; purchase of a sheaf-binding machine; operating resources.
- o The estimated budget is FM 448,500,000.

### 4. Expected results

- o Creation of a milk herd in the Niger Office Zone where forage potential is high (irrigated crops and agro-industrial by-products);
- o Promotion of wool and mutton production to meet increasing demand;
- o Promotion of goat's milk and mutton production;
- o Increase in the income of farmers of the Niger Office directed toward a lucrative form of milk and meat production;
- o Improvement of the work force of the Niger Office ploughing oxen;
- o Increase in the state's foreign currency by reduction of milk imports.

## I. Zebu and Toronke Sheep Breeding Project

### 1. Justification

The Toronke Zebu is believed to be related to the Senegalese Gobra Zebu, which is known for its quality meat. Except for a few general facts, no precise data is available on the productive potential of this breed. This program must be carried out through a series of experiments to define the level of zootechnical performance of the breed and the prerequisites for its improvement.

## 2. Brief description

Rational breeding of the Toronke Zebu and sheep in order to externalize and increase the meat breeding quality of this breed.

Studies on the productivity of different pastures and conditions for their optimum exploitation (restoration, improvement, and rational management).

Dual research in an improved environment (station) and in an extensive environment (extension zone).

On station: herd management, performance tests, determination of control methods which can be used in the traditional environment.

- o Choice of method for genetic improvement;
- o Study of the nutritional value of various local forages; their improvement.
- o These actions require the additional investments in infrastructure (construction of buildings for the animals, housing of personnel, installation of water ducts) and the control of operation and equipment (vehicles and engines, agricultural materials).

In the extension zone, the project requires:

- o Study of the system for herd management and possibilities for its adaptation to modern livestock methods;
- o Field tests on animals;
- o Definition of an improvement strategy for the different genotypes used in the production systems in place;
- o Production management.

These activities require constructing and equipping facilities for round ups (and vaccinations) with weighbridges and vehicles as well as material (pharmaceutical products, etc.).

The estimated duration of the project is five years.

## 3. Resources

- o Human resource needs include two veterinarians, two zootechnicians, five animal husbandry technicians, one agrostologist and five agricultural technicians;
- o Equipment needs include two vehicles, four offices, two stables, agricultural supplies, genetic material (cattle, sheep), operational materials (fuel, research equipment), equipment and buildings.

- o The estimated budget is FM 565,800,000.

#### 4. Expected results

- o Creation of a herd with high meat breeding qualities in the first region (Toronke expansion zone);
- o Promotion of animal feeding at the farm level (cattle and sheep);
- o Increase in income for the farmers instructed through rural development projects in the zone;
- o Improvement in the working strength of draught animals in the zone;
- o Increase in the state's foreign currency through the export of animals to Senegal.

### J. Program for Genetic Improvement by Breeding the Azaouack Zebra

#### 1. Justification

The Azaouack zebras are considered to be the country's best milk cattle, but they have not undergone any improvement in Mali. Except for a few general facts, no precise data are available on the breed's potential.

Here, selection is necessary to maintain the breed's purity and to develop good stock to increase the production of milk and meat.

The Ansongo zone appears to be an appropriate location to set up a Station for this breed.

#### 2. Brief description

The objectives are to maintain the purity of the breed by avoiding any undesirable crossbreeding, as well as

- o Improve traditional livestock by breeding good stock and its extension in the zone, and by rational use of natural pastures;
- o Develop herding of the Azaouack breed with improved extension;
- o Set up workshops for intensive production of milk and meat;
- o Study the production behavior of the breed in the extensive environment.



Set up a follow-up field study of the animals through intensive extension (in cooperation with the livestock services) in order to:

- o Determine breeding criteria (breeding objective) specific to the current qualities of the breed as they relate to ecological and socio-economic conditions;
- o Identify genetic parameters on sufficiently representative samples of the breed and the livestock conditions;
- o Define a breeding plan covering the entire zone with a potential to optimize this plan;
- o Promote large-scale production through permanent technical support to the production units.

The on-station's in-house duties shall consist of:

- o Performance control;
- o Herd management; feasibility study to reach optimal milk production (dairy herd) and meat (steer and young males) production;
- o Study natural pastures;
- o Productivity of pastures;
- o Nutritive values of forages throughout production cycle;
- o Restoration of pasture lands;
- o Forage crops;
- o Investments in infrastructure (service buildings, housing), in equipment (vehicles and supplies, agricultural equipment, etc.) and personnel.

The station's field activities will include:

- o Zootechnical testing of animals (identification, performance control) extension to herders (mass medicine, clinical care);
- o Investment in equipment (vehicles, weighbridges), infrastructure (corrals) materials (pharmaceutical products) and personnel.
- o The estimated duration of the project is five years.

### 3. Resources

- o Professional staff needs at the Zebu Azaouack Station are a directing veterinary doctor, an ISA livestock engineer and an ISA agrostologist;

- o Middle management needs include: an ITE zootechnician and an accountant;
- o Other employee and skilled worker needs are:
  - Five medical attendants;
  - One secretary;
  - Two drivers;
  - Two tractor mechanics;
  - Ten shepherds;
  - Ten manual laborers.
- o In terms of equipment, the following is needed: livestock building and annexes for housing and offices, vehicles and tools, breeding supplies, animals, feed, fuel and maintenance, and veterinary products.
- o The estimated budget is FM 393,600,000.

#### 4. Expected Results

- o Creation of a data bank on the Azaouack bovine breed, known for its milk production capacity;
- o Development of a highly productive milk herd;
- o Improvement of the nutritional level of milk;
- o Improved standard of living for the herders in the region.

### K. Program for Cattle and Sheep Breeding in the Gao Region

#### 1. Justification

- o This region of the country has great potential for animal production but has not as yet been included in research in the areas of cattle, sheep, and goat breeding zone in the areas of cattle, sheep, and goat breeding in the zone for the production of meat and wool (sheep);
- o Studies on the productivity of different pastures (flooded and dry) and the conditions for their optimal use (restoration, improvement and rational management);
- o Possibilities for use of Sahel genotypes in the humid zones (principally small ruminants).

#### 2. Brief description

- o Dual research in the improved environment (station) and the extensive environment (extension zone); and

- o On station: herd management, performance control, determination control, determination of control methods which can be utilized in the traditional environment, choice of methods (genetic improvement), and study of the nutritional value of different local forages and their improvement.

These activities require the restoration of an old sheep pen, equipping the station with infrastructure (buildings for the animals, housing for the personnel, water supply system), and management of operations and personnel.

In the extension zone, it is necessary to undertake a study of the system for herd management and the possibilities for its adaptation to modern livestock methods, as well as to coordinate extension on production, continuous testing of the animals, and to define a strategy for improvement of the different genotypes used in the current production systems.

These activities require construction and equipment of corrals and vaccination pens with weighbridges and vehicles.

The estimated duration of the project is five years.

### 3. Resources

#### a. Human resource needs

- o Senior Management: one directing veterinary doctor, one agrologist, and two livestock engineers;
- o Middle Management: three livestock operations engineers, one agrologist, and one accountant;
- o Employees and Skilled Workers: five veterinary nurses, two secretaries, 15 shepherds, five drivers, two tractor drivers and 20 workers and laborers.

#### b. Plant and equipment needs

- o Livestock buildings and annexes;
- o Housing and offices;
- o Vehicles and engines;
- o Purchase of animals;
- o Hydraulics;
- o Livestock breeding material;

- o Feed; and
- o Veterinary products.

c. Estimated budget

The project's estimated budget is FM 465,205,000.

4. Expected results

- o Production of animals bred for wool and meat qualities;
- o Better conditions for extension of research results;
- o Increase in the productivity of the animals of the region;
- o Promotion of livestock conditions;
- o Improvement of the standard of living of the herders.

## VIII. VETERINARY RESEARCH

### A. Support for the Construction of a Pathology Unit for Small Ruminants

#### 1. Justification

To permit the construction of a structure more specifically designed for the epizootiology of parasitic and infectious diseases affecting sheep and goats. On the basis of these studies, to identify new areas for research.

#### 2. Brief description

The construction of a pathology unit for small ruminants will permit systematic investigation (serological, parasitological) into the incidence of the various diseases. At the conclusion of these investigations, a broad outline for research will be determined which can assist in combatting the diseases which threaten sheep and goats in Mali. A vaccine preparation unit is already operational. The estimated duration of the project is five years.

#### 3. Resources - Estimate of costs

	FCFA
o Infrastructure	80,000,000
o Equipment	15,000,000
o Transportation	20,000,000
o Refrigeration equipment	6,000,000
o Production of vaccine and prospecting	10,000,000

#### 4. Expected Results

Project already proposed to the livestock services by the Central Veterinary Laboratory with the aim of improving the health of small ruminants.

### B. Material Support for Epidemiological Studies

#### 1. Justification

Knowledge on the health of Malian sheep and goat herds is necessary in order to orient any research program. The establishment of sampling resources by region permits rapid action when disease centerforms and correspondingly shortens the time needed to obtain a diagnosis from the central laboratory.

## 2. Brief description

To permit the laboratory to conduct five-year follow-up tests of epizootiological investigations on gastrointestinal parasitoses and infectious diseases. Provide the eight regions with sampling equipment.

This project is subordinate to the development of a pathology unit for small ruminants. The estimated projection duration is five years.

## 3. Resources - Estimate of costs

o Purchase of two four-wheel drive vehicles	6,000,000 FM
o Equipping vehicles with refrigeration	600,000 FM
o Operation of vehicles (5 years)	12,400,000 FM
o Blood sampling equipment (5 years--8 regions)	24,000,000 FM
o Processing of results	1,000,000 FM
o Total	<hr/> 44,000,000 FM

## 4. Expected results

Respond to the pathological problems of the small ruminants, control the epizootiology as regards gastro-intestinal parasitoses and infectious diseases.

## C. Epidemiological Investigation of the Animal Brucellosis

### 1. Justification

Focus on the health and economic consequences of animal brucellosis in Malian livestock.

### 2. Brief description

Investigations conducted in a number of livestock stations during the 1970's showed that brucellosis was widespread in Mali. Studies on the extent of this disease from a significant sampling of the livestock in Mali will provide an idea of its effects. This evaluation will cover the serological studies in the field and isolation work on brucella in the laboratory. The estimated duration of the project is five years.

### 3. Resources - Estimate of costs

o Investment:	FM 39,000,000
o Infrastructure	FM 5,000,000

o	Transformation of an LCV room into a brucellosis laboratory	FM 5,000,000
o	Laboratory equipment and technical material	FM 22,000,000
o	Hood with vertical sheet metal flu 2 x 5,000,000	FM 10,000,000
o	CO <sub>2</sub> incubator (2 x 3,000,000)	FM 6,000,000
o	Reagents and culture media	FM 3,000,000
o	Diagnostic material	FM 3,000,000
o	Transportation: a Land Rover	FM 12,000,000
o	Operations:	
o	Vehicle 400 FM/km x 25,000 km	FM 10,000,000
o	Personnel (training) 1 month study trip for a veterinary inspector	FM 2,000,000
o	Expert consultant on brucellosis 2 x 15 days	FM 3,000,000
o	The project total is	FM 56,700,000
	-- Investments	FM 39,000,000
	-- Operations	FM 15,000,000
	-- Miscellaneous five percent	FM 2,700,000

4. Expected results

Control of brucellosis.

## IX. FORESTRY AND HYDROBIOLOGY

The general objectives are to fight against, to satisfy the populations's needs, and to inventory fishing resources.

The research programs have been set up for the long-term and research themes (for the short and middle term) are covered by projects.

### A. Study of the Production Techniques in the Nursery for Local Forest Species and Potential for Reproduction In and Off Station.

#### 1. Justification

A landlocked country, Mali figures among the countries of the Sahel which have suffered from drought. Protection of the environment and restoration of ligneous plants are among the principal objectives of the latest five-year plan (1981-1985).

The present project was conceived in the context of development work on local forest species and efforts to satisfy the population's energy demand in terms of ligneous combustibles.

For the last ten years, all possible resources have been allocated to overcoming the drought and the phenomenon of desertification. Encouraging results have been obtained from Operation Forest Development and Production, under which vast forest areas have been planted in the regions of Bamako and Koulikoro, and Operation Reforestation and development of Sikasso, which incorporates all the villages in the region in its reforestation activities. Furthermore, the forest service is initiating the planting of green belts around the urban centers such as Kayes, and provides the population with plants which have been raised in a large number of nurseries throughout the country.

However, all the reforestation efforts would be in vain had not a specific emphasis been placed on indigenous forest species that are already adapted to local climatic conditions. Their production in the nurseries has not yet been mastered, despite the existence of a research station for indigenous species, which unfortunately has very limited resources at its disposal.

#### 2. Brief description

The project envisions:

- o Local planting of "seed-bearing" trees and the organizing of the harvest of the seeds;
- o The development of areas for seed conservation, treatment and storage;



- o The creation of nurseries for germination tests and studies of the behavior of plants in the nursery;
- o Studies on on-station transplants and off-station enrichment;
- o Training Malian personnel.
- o The estimated project duration is three years.

### 3. Resources

- o Human resource needs include: one engineer, two technicians, one secretary, five laborers, one foreman, and one driver;
- o Equipment needs are: Vehicles (one tractor (60 hp) and one four-wheel drive vehicle), water supply equipment (one well, one motorized pump and pipes, and one tank (3 m<sup>3</sup> of water), a nursery fence (18 rolls of lattice work, 14 rolls of barbed wire, and 170 two-meter angle bars, five rolls of bracing wire, 10 kg of tie wire, 50 kg of wire, and installation equipment), small equipment (five wheelbarrows, five watering cans, five buckets, three shovels, three picks, five daba hoes, three hoes, one crow bar, three rakes, two local knives, two pruning shears, two hatchets, ten m string cord, 50 m nylon cord (0 16)), technical material (scales, jars, chemicals) and local development (offices, warehouses).
- o The estimated budget is FM 183,216,000.

### 4. Expected results

The present project has the following goals:

- o To better understand the nursery production techniques for local forest species;
- o To determine the behavior of plants in the nursery;
- o To determine adequate transplanting methods on station and off-station enrichment;
- o To counsel the forest service on all planting and reforestation activities;
- o To provide nursery techniques to forest development and reforestation operations.

## B. Improvement of Sap-drainage Techniques for the Senegalese Acacia

### 1. Justification

The Senegalese Acacia is one of the rare forest species existing in natural formations on the edge of the desert with

approximately 50,000 ha. Consequently, it could become the ideal species for the fight against desertification. It presents many advantages, including:

- o It can survive in very difficult ecological conditions;
- o It holds soil with its highly developed root system;
- o It fixes atmospheric nitrogen and thus improves the soil;
- o It provides good firewood and yields excellent charcoal;
- o It is used as aerial forage, and its pods and leaves are eaten by sheep, goats and camels;
- o It produces a quality gum with a variety of uses (preserves, cosmetics, pharmaceutical products, etc.).

The price of the gum has been increasing each year due to the rising demand from industry. As a result, the tree has been over-tapped through excessive sap drainage, which kills the tree.

## 2. Brief description

Project plans include:

- o Selection of two representative plots, 10 ha each for experimentation;
- o Construction of buildings (warehouses and offices);
- o Installation of measurement instruments (pluviometer, thermometer, wind gauge, etc.);
- o Studies on growth in relation to the method of regeneration (artificial or natural);
- o Soil analyses;
- o Evaluation of gum production in relation to the sap-draining period;
- o Possibilities for improving the production of gum through supplemental water supply.
- o The estimated project duration is seven years.

## 3. Resources

- o Human resource needs include six engineers, ten technicians, two secretaries, four drivers, ten laborers, and two guards.
- o Equipment needs include: Vehicles (two four-wheel drive and two light vehicles and ten mobylettes); research material;

construction of buildings; water supply equipment (two wells, two motorized pumps and accessories, two reservoirs); and fences.

- o The estimated budget is FM 640,000,000.

4. Expected results

The project goals are as follows:

- o To master the techniques of sap-drainage for optimum production of gum while avoiding any damage to the tree;
- o To extend the appropriate sap-draining methods to the rural populations;
- o To train Malian technical personnel;
- o To counsel a development plan integrating gum production with agriculture and livestock.

C. Ichthyological Research in the Niger Central Delta

1. Justification

The economy of Mali is based essentially on the primary sector. With an annual production of fresh fish of approximately 100,000 metric tons, fishing occupies third place in the economy after agriculture and livestock. This large quantity is caught in the Senegal River and above all the Niger-Bani Central Delta and places Mali among the top African producers of freshwater fish (FAO-1965).

Approximately 90 percent of this production is processed into smoked or dried fish for shipment inland of the country or toward neighboring countries: the Ivory Coast, Upper Volta, and Ghana. Fish plays an important dietary role in general and in the developing countries in particular as a source of animal protein which can compensate for the lack or high cost of meat. Because of this, this natural resource must be very carefully managed to avoid depletion of stocks. This management must be preceded by the most detailed possible knowledge of the availability of the fish species in different waters. Therefore, the present project was conceived within the context of an inventory of fishing resources. This inventory was found to be necessary because, for almost a decade, we have seen the situation worsen, for example, reductions in catches and fish levels and less efficient fishing tackle.

2. Brief description

In the first stage, priority must be given to the determination of the fishing potential of the Central Delta and the prevention and cessation of depletion of stocks. An estimate of the annual production of fish in relation to the conditions of the area

and biological study of the principal fish species with a view toward fish breeding to assure sufficient production can be undertaken in the second stage. The estimated project duration is five years.

### 3. Resources

- o Human resource needs include one ichthyologist, one permanent consultant, three engineers, six technicians, five permanent fishermen, one secretary, three drivers, two small-craft operators, two guards, five statistical agents, and ten laborers;
- o Equipment needs include: vehicles (one 4-wheel drive vehicle, two light vehicles, and ten mobylettes); fishing equipment (two seines, six fishing nets, two canoes and two outboard motors); and laboratory supplies.
- o The estimated budget is FM 596, '93,500.

### 4. Expected results

- o Determination of the fishing potential of the Niger Central Delta and prevention or cessation of stock depletion;
- o Estimation of the annual production of fish in relation to the environmental conditions.
- o Study of the biology of the principal species of the region with a view toward fish breeding: Tilapia, Synodontis, Lates, Bagrus, Auchenoglanis, Heterobranchus, Mornyrus, Chrysichthys.

## D. Research Project on Wild Mammals

### 1. Justification

The contribution of wildlife to the human diet in Mali, although not perfectly understood, is significant because of the size of the country, the diversity of ecological zones and the large size of the rural population.

The drought of recent years has severely disturbed the habitat of the wild fauna. Certain species are threatened with extinction, while others have made large-scale migrations. But the degree of these disturbances and their consequences on the lives of the wild species is still not very well understood. Five years ago this situation led the government of the Republic of Mali to adopt measures prohibiting all hunting. The effects of these measures have still not been evaluated. There is an urgent need to conduct studies to better understand the ecology of the principal species, as well as their parameters for reproduction. Such studies may help to better discern the conditions appropriate for their possible use by man, principally for food and secondarily for leisure.

## 2. Brief description

- o Creation of two bases (Asongo and Douentza) to accommodate the necessary personnel and equipment for the implementation of the project. These bases will allow coverage of the Mali Gourma and the wildlife reserves near the Niger River;
- o Field tests on the ecosystem, food and biological conditions for various wildlife species;
- o Aerial counting of the species supported by ground investigations;
- o Investigation of the production designed for human consumption (sampling from the wildlife population);
- o Proposal of measures for the rational production and hunting of the fauna.
- o The estimated duration of the project is five years.

## 3. Resources

- o Project personnel is available locally, although some of the staff will require specialized training.
- o Equipment needs include: infrastructure and equipment for the wildlife preserves; the estimated cost is FM 575,000,000.
- o The estimated budget is FM 1,025,000,000.

## 4. Expected results

- o Knowledge of the principal species of wild mammals, principally giraffes, elephants and various cervidae;
- o Populations;
- o Parameters for reproduction;
- o Mortality;
- o Ecology;
- o Proposal of measures for field tests on population dynamics, for improvement of environments and to set guidelines for rational use.

## E. Technological Study of the Principal Savannah Species

### 1. Justification

Mali is a continental country with a savannah forest, in which the principal ligneous formations are concentrated in the south of the country, constituting the sources of wood supply.

This wood is much in demand in the construction, carpentry, and agricultural equipment manufacturing sectors.

The extent of wood requirements is revealed not only by the abusive exploitation but also by the utilization of all sorts of local species. Since these ligneous resources are limited and requirements are continually increasing, Mali has chosen to develop its local forests. This new orientation has spurred the creation of development and reforestation operations in the south and center of the country. However, no such operation can be carried out without previous knowledge of the techniques and the plant materials to use for reforestation. Because Mali lacks data on local species, to date only foreign species have been used in reforestation efforts.

The mechanical properties and anatomic structures (ligneous structure, growth rings) of savannah woods in Mali are still poorly understood. However, better use of these woods will require in-depth knowledge of these elements. Similarly, an understanding of the growth rate of a tree and its behavior according to age and climate would permit the development of more appropriate forestry techniques, for example the selection of a species according to expected use and as a function of its growth rate.

Thus, more research is required before these development operations can be carried out.

### 2. Brief description

The species selected for study will be chosen by the degree of economic importance (wood production or secondary products). Included would be species such as Pterocarpus erinaceus, Khaya senegalensis, Isoberlinia doka, Afzelia africana, Bombax costatum, Butyrospermum parkii, Diospyros mespiliformis, and Daniellia oliverie. Foreign species such as Tectona grandis and Gmelina arborea can also be covered by the study.

A study of the mechanical properties of this wood will be conducted focusing primarily on the study of the anatomical structures of growth rings (nature and periodicity) as well as on dendro-climatological studies. These studies will address themselves principally to the Bamako, Segou and Sikasso regions.

The project is expected to last three and one-half years.

### 3. Resources

- o Human resource needs include one M.S. scientist, one water and forestry engineer, two technicians, one secretary, one driver, two carpenters, one saw setter, two sawyers, one guard, and five laborers;
- o Equipment needs include: vehicles (one 4-wheel drive vehicle); research and office material (wood anatomy laboratory equipment, photography equipment, mechanical testing equipment, carpentry materials, and documentation); building development (climatization chamber and darkroom).
- o The estimated budget is FM 140,206,000.

### 4. Expected results

This knowledge on the savannah species will serve as a working tool for development operations in this field and for the broader context of setting policy for the development of natural forests.

## F. Pilot Paper Plant Project

### 1. Justification

The present project was designed after due consideration of earlier research findings. The results of this research project on paper could permit:

- o A reduction in paper imports which would permit more funds to be directed toward the development of Mali's arid zones for the production of wood, of which a portion could be used for the production of cellulose pulp;
- o Grouping farmers in cooperatives to supply raw materials to the plant, which would constitute a considerable source of income for them;
- o The creation of new jobs in rural areas, by adding value to agricultural by-products.

### 2. Brief description

Projects plans include:

- o Equipping and operating a pilot plant;
- o Continuing research;
- o Training Mali personnel;
- o Producing paper at the village scale.

- o The estimated project duration is three years.

### 3. Resources

#### a. Human resource needs

In addition to qualified technicians, the project will require employment of a labor force to gather raw materials.

The staff will be composed of a water and forestry engineer, two senior water and forestry technicians, nine contract personnel, of which seven will be laborers, one driver and one secretary.

#### b. Plant and equipment needs

Equipment will include all machines and apparatuses which will be used to equip the plant, the laboratory and office materials, and the necessary transportation resources, a liaison vehicle and two mobylettes.

The estimated budget is FM 180,000,000.

### 4. Expected results

Establishment of production plants which can eventually supply domestic demand.

## G. Research on Selected Dune Forest Species

### 1. Justification

This project is being conducted as part of the fight against desertification and will help identify the forest species which are most likely to take hold in the dunes.

### 2. Brief description

- o Creation of a nursery equipped for irrigation;
- o Study of the method of irrigation and the behavior of the plants in the nursery;
- o Creation of transplant plots to be used to study the behavior of plants in natural conditions.
- o The estimated project duration is four years.

### 3. Resources

- o Human resource needs include two water and forestry engineers, four senior technicians, and support and maintenance personnel:



- o Equipment needs include vehicles: two 4-wheel drive vehicles, nursery equipment, irrigation equipment, and supplies for fences.
- o The estimated budget is FM 270,000,000.

4. Expected results

Creation of more fertile land, regeneration of plant cover, and creation of pastures.

H. Study of Restoration Techniques for the Soil of Southern Mali

1. Justification

Problem of durable fallow land; recuperation and enrichment of depleted and nearly depleted soils through reforestation with appropriate species.

2. Brief description

Project plans include:

- o Study of soil restoration techniques;
- o Creation of a nursery and research support base;
- o Creation of transplant plots in order to study the behavior of plants;
- o Studies for rational use of land in order to fight against the pressure caused by itinerant agriculture.
- o The estimated project duration in five years.

3. Resources

- o Human resource needs include two water and forestry engineers, seven technicians and maintenance and support personnel;
- o Equipment needs include vehicles, nursery equipment, irrigation equipment and supplies for fences.
- o The estimated budget is FM 540,000,000.

4. Expected results

The principal result of this project will be a rationalization of the use of agricultural land.